X-6114

MAINTENANCE MANUAL

GM
GENERAL MOTORS CORPORATION
COACHES

COACH MODEL
PD-4106

GMC TRUCK & COACH DIVISION
GENERAL MOTORS CORPORATION
Pontiac, Michigan

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INDEX

INTRODUCTION

This manual contains complete service, maintenance, and repair information on GM Inter-City Coach Model PD-4106. Information in this manual pertains to standard equipment and the most commonly used special equipment.

Operation of the vehicle from the standpoint of the driver is contained in a separate Operating Manual. For information on the Diesel Engine, refer to the current Diesel Engine Maintenance Manual.

Every effort has been made to include timely and adequate information on the various units and systems used on the PD-4106 Coach. The maintenance and repair procedures in the various manual sections are the result of extensive service experience. This information should serve not only as a reference for the experienced mechanical force, but also as a comprehensive text for training purposes.

All information contained in this manual is based on the latest product information available at the time of publication approval. GMC Truck and Coach Division reserves the right to make product changes at any time.

GENERAL INFORMATION ABOUT THIS MANUAL

MANUAL ARRANGEMENT

This manual is divided into major sections in the sequence shown on the margin of the title page. A black tab bearing the major section number is placed on the first page of each major section which indexes with the tab on the title page. Many of the major sections are divided into sub-sections, each sub-section containing important and specific information on related units or components. When a major section is divided into sub-sections, a section index appears on the first page of the major section.

PAGE AND ILLUSTRATION NUMBERS

The manual pages are numbered consecutively within each major section. Illustrations are numbered consecutively within each section, or within each sub-section when the major section is so divided.

SPECIFICATIONS

Service data, fits, and tolerances are listed at the end of most sections or sub-sections under the heading "Specifications." Manufacturers model or part numbers are used in many instances in the "Specifications" tabulation. These numbers are provided primarily for unit identification and should be referred to when ordering parts. All detail service part numbers must be obtained from the applicable Parts Book.

SPECIAL TOOLS

Special tools and equipment are mentioned, and in many instances illustrated, throughout the text. These tools are specially designed to accomplish certain operations efficiently and readily. Such tools are identified in the text by tool vendor's numbers. These tools are not offered for sale by GMC Truck and Coach Division. Information regarding availability of these tools can be obtained from your GM Coach Service Representative or from the Factory.

SERVICE BULLETINS

Service bulletins are issued, when required, supplementing or in some cases superseding information in this manual. Information in these bulletins should be noted in the text and the bulletin filed for ready reference.

ALPHABETICAL INDEX

Important subjects, with manual section and page number references, are alphabetically listed at the end of this manual.

GENERAL DATA

The data listed below includes only general information on the PD-4106 Coach. For specific data and specifications, refer to "Specifications" at end of each section or sub-section.

MODEL DATA

Length (overall)	35 ft.
Width (overall)	95½ in.
Height	
Front (at axle)	121 in.
Rear (at axle)	121½ in.
Wheelbase	261 in.
Track	
Front	78⅞ in.
Rear (center of dual tires)	70½ in.
Turning Radius	
Wheels (right and left)	38 ft. 6 in.
Body Corner (right and left)	42 ft.
Tire Size (standard)	11.00/20
Fuel Tank Capacity	140 gal.
Cooling System Capacity (including heating system)	92 qts.

ENGINE DATA

Engine Model	8V-71
Displacement	567.5 cu. in.
Bore and Stroke	4¼ in. x 5 in.
Compression Ratio	17:1
Brake Horsepower at Governed Speed (1650 rpm)	235

SERIAL NUMBER LOCATIONS

Delay and confusion can be avoided when correct serial numbers of vehicle and engine are placed on parts orders and correspondence. Locations of these serial numbers are illustrated below.

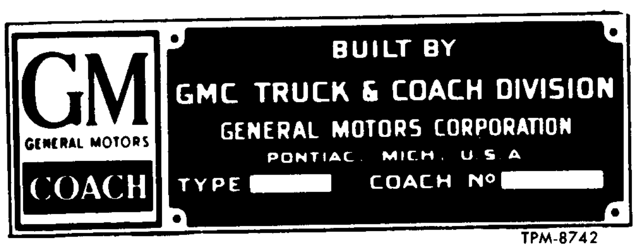
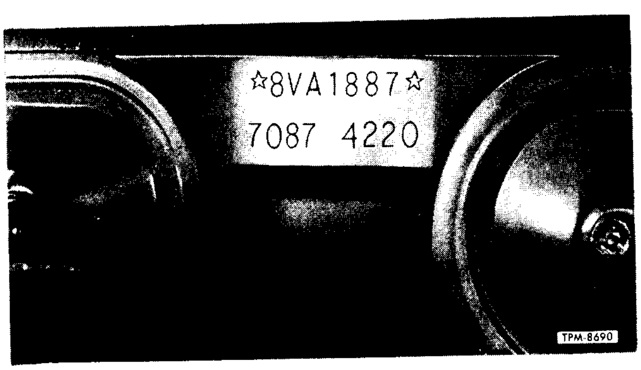


PLATE ON RIGHT SIDE OF DASH



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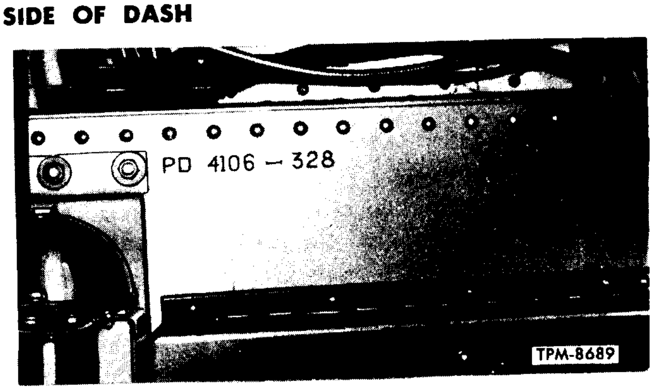


ON BULKHEAD IN TOOL COMPARTMENT

Front Axle

This group is divided into two sections covering "FRONT END ALIGNMENT" and "FRONT AXLE REPAIR."

1

Front End Alignment

Proper front end alignment must be maintained to insure ease of steering and satisfactory tire life.

Front end alignment inspections generally fall into two groups: (1) Regular service inspections performed at periodic intervals, and (2) Inspections to determine extent of damage after a collision or severe service.

Regular service inspections are primarily concerned with toe-in, camber, and caster. With proper equipment these specifications are easily checked. Any variation from these specifications will indicate: (1) need for adjustment, or (2) more thorough inspection to determine if any steering or front axle parts are bent and require replacement.

Complete front end alignment data is given under "Specifications" at end of this section.

DEFINITION OF TERMS

WHEEL TOE-IN. Distance front wheels are closer together at front than at rear of axle (see "G" and "H," fig. 1).

WHEEL CAMBER. Amount wheels are inclined from vertical plane (see "C," fig. 1).

FRONT AXLE CASTER. Inclination of king pin from the vertical in the fore and aft direction of the vehicle (see "X," fig. 1).

KING PIN INCLINATION. The slant of the king pin toward the center of the vehicle at the top and outward at the bottom (see "D," fig. 1).

STEERING GEOMETRY. The design of the front end which causes the front wheels to stay in proper relative alignment when the wheels are turned to right or left.

FRONT END INSPECTION

Before checking front end alignment, the following front end inspection should always be made:

1. Check tires for proper inflation.
2. Check wheel installation and run-out.
3. Check wheel bearing adjustment.
4. Check tie rod and drag link ends for looseness.
5. Check king pins for looseness.

Front end alignment requires the vehicle to be level while being checked. Full weight must be on wheels with vehicle empty.

ALIGNMENT

FRONT WHEEL TOE-IN

Toe-in is measured from centers of tire tread. Measurements at both front and rear of axle (see "H" and "G," fig. 1) must be made at same height from floor.

First hoist front of vehicle and spin wheels to obtain a center line on tire treads.

Place wheels in straight-ahead position.

Roll the vehicle straight ahead for several feet to where the inspection is to be made. This will remove any slack caused by looseness in the wheel bearings or steering connections.

Measure at point "H" and "G" (fig. 1). Toe-in is "G" minus "H."

Incorrect toe-in results in excessive tire wear caused by side slippage. Unstable steering with a tendency to wander may also result.

Toe-in Adjustment

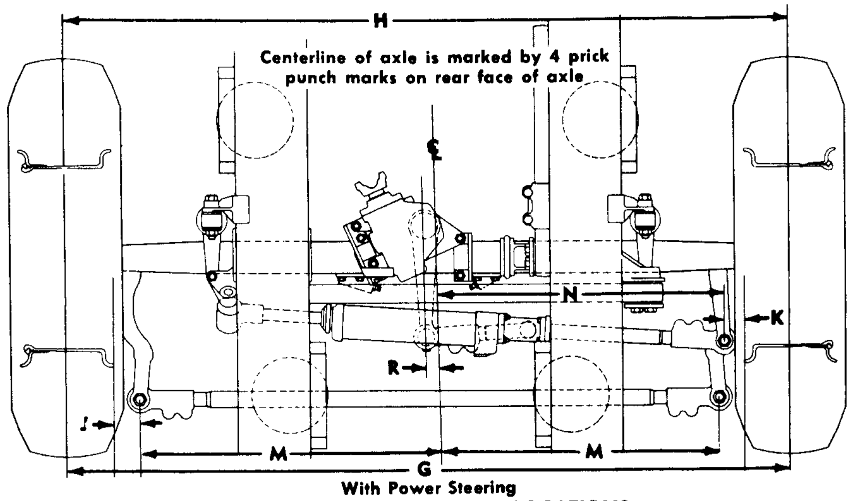
1. Loosen clamp bolts which retain each tie rod end on tie rod.
2. Using a pipe wrench, turn tie rod tube as required to obtain correct toe-in measurement.
3. After correct adjustment is obtained, make certain that both tie rod ends are in the same plane; then tighten all clamp bolts firmly.
4. Recheck toe-in to make sure adjustment was not changed when clamp bolts were tightened.

FRONT WHEEL CAMBER

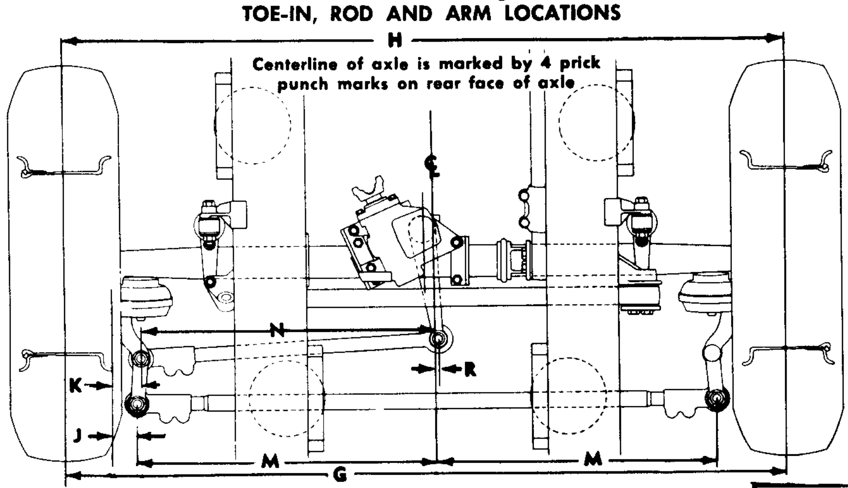
Positive Camber is outward inclination of wheels at top; Negative or Reverse Camber is inward inclination of wheels at top. This vehicle is designed with positive camber. Camber variations may be caused by wear at wheel bearings and steering knuckle bushings, or by a bent steering knuckle or sagging axle center.

In checking camber it is recommended that an

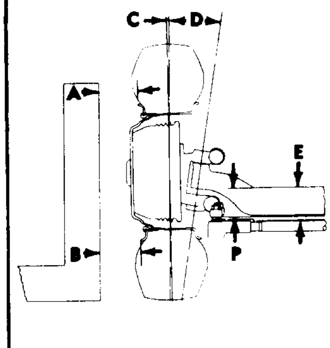
FRONT END ALIGNMENT



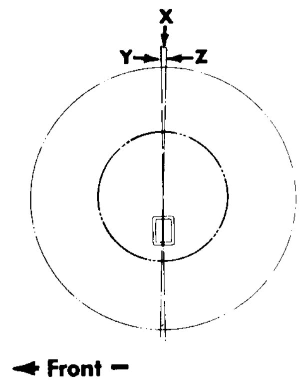
With Power Steering
TOE-IN, ROD AND ARM LOCATIONS



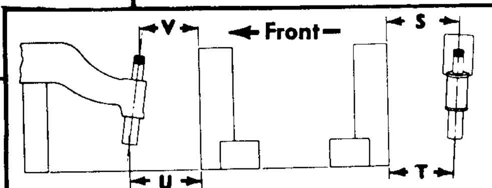
With Mechanical Steering
TOE-IN, ROD AND ARM LOCATIONS



CAMBER, PIN INCLINATIONS, AND ROD LOCATIONS



FRONT AXLE CASTER



KING PIN INCLINATION   CASTER

B MINUS A Camber (Inches)
C . . . . . . Camber (Degrees)
D . . . . . . King Pin Inclination (Degrees)
E . . . . . . Top of Tie Rod Tube Below Top of Axle
G MINUS H Front Wheel Toe-in (Inches)
J . . . . . . Centerline of Tie Rod End Stud to Wheel Rim
K (MECH.) Centerline of Drag Link End Stud to Wheel Rim
K POWER) Centerline of Extension End Stud to Wheel Rim
M . . . . . . Centerline of Axle to Center of Tie Rod End Studs
N (MECH.) Centerline of Axle to Center of Steering Arm End (At Drag Link)
N (POWER) Centerline of Axle to Center of Extension End Stud
P . . . . . . Bottom of Tie Rod Arm Boss to Top of Axle Beam
R (MECH.) Centerline of Axle to Center of Pitman Arm Stud
R (POWER) Centerline of Axle to Center of Pitman Arm Stud
S MINUS T Caster (Inches) (Measure at Front of Axle)
U MINUS V King Pin Inclination (Inches)
X . . . . . . Caster (Degrees)
Y . . . . . . Vertical
Z . . . . . . Centerline of King Pin

Refer to "Front End Alignment Data" for numerical values.

TPM-7752

Figure 1—Front End Alignment Chart

accurate gauge be used. If a camber gauge is not available, readings can be taken as illustrated at "A" and "B" on chart (fig. 1). Place square as shown and measure distance between "A" and rim, and "B" and rim. Lower dimension should exceed upper dimension by amount listed in "Front End Alignment Data" at end of this section. This dimension on right wheel should not vary over 3/32" from same dimension taken at left wheel.

If final camber reading is incorrect, either steering knuckle or axle center is bent. To determine which part is bent, check king pin inclination ("D," fig. 1). Camber plus king pin inclination is the INCLUDED ANGLE of steering knuckle. If included angle of knuckle varies more than 1/2 degree from values given in "Front End Alignment Data," knuckle is bent.

Excessive positive camber results in irregular wear of tires at outer shoulders. Negative or reverse camber causes wear at inner shoulders. Ease of steering is affected by any deviation from specified camber.

AXLE CASTER

Positive Caster is the inclination of the king pins toward rear of vehicle. Negative or Reverse Caster is the inclination of king pins toward front of vehicle. This vehicle is designed with positive caster.

Caster variations may be caused by bent axle, or tilting of side suspension supports. Precision instruments must be used to check caster angles when axle is installed in vehicle.

Caster can be adjusted on vehicle by loosening clamp bolts in adjusting clamp (fig. 2) and turning clamp. Adjust to dimension listed in "Front End Alignment Data" on next page. Tighten clamp bolts firmly after adjustment.

When axle is removed from vehicle, check can be made on bench as follows:

Place two uniform blocks on level surface. Rest suspension support seats on blocks. Using square, measure "S" and "T" dimensions (fig. 1) at front side of axle. "S" minus "T" equals caster in inches. If this dimension does not agree with specified value, the axle is twisted.

The purpose of caster is to provide steering stability by keeping the wheels in a straight-ahead position. Variations from specified caster values will affect steering stability causing wandering, difficulty in pulling out of curves, and a tendency toward wheel shimmy.

KING PIN INCLINATION

Precision instruments must be used to check king pin inclination when axle is installed in vehicle.

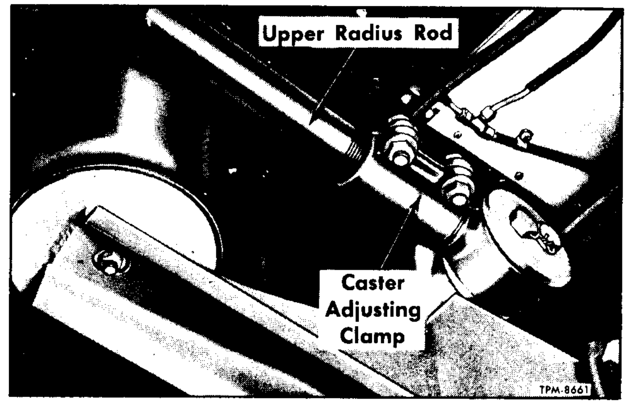


Figure 2—Caster Adjusting Clamp

When axle is removed, check can be made on bench as follows:

Place two uniform blocks on level surface, rest suspension support seats on blocks. Using square, measure "U" and "V" dimensions (fig. 1). "U" minus "V" equals king pin inclination in inches.

If axle is bent or twisted, refer to "Straightening Axle Center" later in this section for corrective information.

STEERING GEOMETRY (Refer to Fig. 1)

Since the angularity of the steering arms largely controls steering geometry, checking the alignment of the steering arms and linkage is an important alignment factor.

After making all other front end alignment checks, inspect steering arms for proper installation, then measure steering arm angles as follows:

1. Position of top of tie rod tube below top of axle ("E").
2. Distance of center of tie rod end studs to edge of wheel rims ("J").
3. Distance from center of drag link end stud to edge of wheel rim ("K") (Mech. Steering).
4. Distance from center of extension end stud to edge of wheel rim ("K") (Power Steering).
5. Distances of center of tie rod end studs to centerline of axle ("M").
6. Distance from centerline of axle to center of steering arm end (at drag link) ("N") (Mech. Steering).
7. Distance from centerline of axle to center of extension end stud (at steering arm) ("N") (Power Steering).
8. Distance of center of Pitman arm end stud to centerline of axle ("R").

If these dimensions are not within specified values, the steering arms or steering linkage are bent and should be replaced.

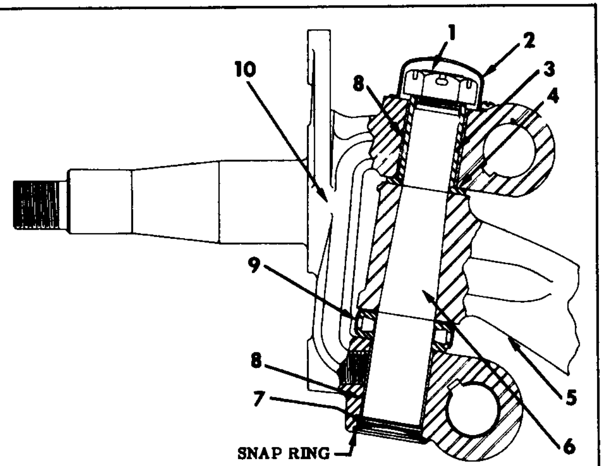
Refer to next page for "Front End Alignment Data."

FRONT END ALIGNMENT DATA
(Refer To Front End Alignment Chart, Figure 1)

POINTS ON CHART		DIMENSIONS
B MINUS A	Wheel Camber (Inches)	13/32
C	Wheel Camber (Degrees)	1
D	King Pin Inclination (Degrees)	8
E	Top of Tie Rod Tube Below Top of Axle (Inches)	5 7/8 plus or minus 1/8
G MINUS H	Front Wheel Toe-in (Inches)	1/8 plus or minus 1/32
J	Centerline of Tie Rod End Stud to Wheel Rim (Inches)	2 15/32
K (MECH.)	Centerline of Drag Link End Stud to Wheel Rim (Inches)	2 7/8
K (POWER)	Centerline of Extension End Stud to Wheel Rim (Inches)	2 1/8
M	*Centerline of Axle to Center of Tie Rod End Studs (Inches)	32 5/32
N (MECH.)	*Centerline of Axle to Center of Steering Arm End (At Drag Link) (Inches)	31 23/32
N (POWER)	*Centerline of Axle to Center of Extension End Stud (Inches)	32 5/8
P	Bottom of Tie Rod Arm Boss to Top of Axle Beam (Inches)	5
R (MECH.)	*Centerline of Axle to Center of Pitman Arm Stud (Inches) (To Right of Centerline of Coach)	1 1/4
R (POWER)	*Centerline of Axle to Center of Pitman Arm Stud (Inches) (To Left of Centerline of Coach)	1/2
S MINUS T (MECH.)	Caster (Inches) (Measured at Front of Axle)	5/8
S MINUS T (POWER)	Caster (Inches) (Measured at Front of Axle)	5/16
U MINUS V	King Pin Inclination (Inches)	1 1/2
X (MECH.)	Caster (Degrees)	1 1/2-2
X (POWER)	Caster (Degrees)	3
	Front Wheel Track at Ground (Inches)	79 1/4

*Centerline of Axle is Prick-punched on Face of Axle Beam

Front Axle Repair



1 King Pin Nut
2 King Pin Cover
3 King Pin Bushing
4 Spacing Washer
5 Axle Center End
6 King Pin
7 Expansion Plug
8 Steering Knuckle Bushing
9 Thrust Bearing Assembly
10 Steering Knuckle

Figure 1—Steering Knuckle Assembly

CONSTRUCTION

Front axle assembly is Reverse Elliott type. Axles are equipped with steering knuckles constructed as shown in figure 1.

Wheel bearings, air suspension, steering gear housing, and brake parts which are mounted on front axle are described in their respective sections in this manual.

Specifications and pertinent front axle service information are given in "Specifications" at end of this section.

Front axle assembly center section is a hollow rectangular tube in which dowel pins are installed to locate air suspension supports. Outer ends of axle are solid forgings machined to accommodate steering knuckles and king pins.

Steering knuckles (fig. 1) are supported on solid king pins which are tapered at center section to fit snugly in tapered holes in axle outer ends. Nut installed at threaded upper end of each king pin locks king pin bushing (3, fig. 1) against washer (4, fig. 1) and secures king pin in axle. King pin nuts are secured by cotter pins.

Load is transmitted from axle center to steer-

ing knuckles through tapered roller thrust bearing assemblies (9, fig. 1). Covers and plugs (2 and 7 fig. 1) exclude dust and moisture from knuckle bushings and serve as lubricant seals. Steering knuckle bushings can be replaced when necessary. Stop screws installed at each end of axle center limit turning angle of front wheels.

FRONT AXLE GENERAL MAINTENANCE

INSPECTION

Following inspection operations should be performed at intervals determined by severity of service.

1. Inspect air suspension support stud nuts and U-bolt nuts. Tighten as directed in AIR SUSPENSION (SEC. 14).
2. Inspect and tighten tie rod arm and steering arm nuts. Torque specifications are shown in "Specifications" at end of this section.
3. Inspect steering arm and tie rod arm nuts for looseness. Tighten if necessary. Also inspect tie rod end stud nuts for looseness and check tie rod ends for wear.
4. When steering difficulty or abnormal tire wear indicate necessity, check front end alignment as previously instructed under "FRONT END ALIGNMENT."
5. Check stop screws and adjust when necessary. Stop screw adjustment procedure is described later.
6. Lubricate front axle parts as instructed in LUBRICATION (SEC. 13).
7. When lubricating front axle parts, observe condition of seals at steering knuckle, tie rod ends, and drag link. If seals are found to be damaged or missing, new seals should be installed immediately.
8. Periodic inspection should be made at steering knuckles to determine if excessive up-and-down movement of knuckles on king pins exists. Since excessive pounding will damage thrust bearing (9, fig. 2), the up-and-down movement of steering knuckles must be kept within prescribed limits. Shims for use in reducing clearance are available.

STOP SCREW ADJUSTMENT

Stop screws installed in front axle center limit front wheel turning angle to right and left. Stop screws must be set properly to give equal turning radius to the right and to left, as well as to limit turning angle and thereby prevent interference between front tires and other parts of coach.

Before setting stop screws, refer to STEERING GEAR (SEC. 16) and be sure Pitman arm is properly installed on steering gear, and be sure steering gear drag link is properly adjusted for length. Also, make sure air suspension is pressurized.

Adjust stop screws as follows:

1. Raise front axle until front wheels are off floor.
2. Turn front wheels to extreme left. In this position there should be 3/4 to 1-inch clearance between tire and nearest point on vehicle. If necessary, turn stop screw in or out to provide 3/4 to 1-inch clearance mentioned above. Secure stop screw setting with lock nut.
3. With wheels turned to extreme left position, measure and record distance from left front tire to nearest point on vehicle.
4. Turn wheels to extreme right position and measure distance from right front tire to nearest point on vehicle. If this dimension is not same as the corresponding dimension at left-hand side of coach, adjust right stop screw to provide same dimensions.
5. When adjustment is completed, road test coach and note if any interference takes place between tires and other parts of coach while making sharp turns in either direction.

FRONT AXLE REPLACEMENT

Refer to AIR SUSPENSION (SEC. 14) for procedures necessary to remove and install front axle assembly.

FRONT AXLE OVERHAUL

Steering knuckles, king pins, and bushings may be replaced without removing front axle assembly from vehicle. However, when front axle assembly requires a complete overhaul, the assembly may be removed.

Certain preliminary inspections can be made, while axle is still mounted on vehicle, which will aid in determining the amount of repair work necessary. Check front end alignment as previously directed in "FRONT END ALIGNMENT" section. Inability to align front end correctly indicates that axle center or steering knuckle is distorted, steering arms are bent, or bushings in steering knuckle yokes are worn beyond limits. Repair procedures on such items as brakes, wheel bearings, and steering gear are covered in respective sections of this manual.

STEERING KNUCKLE REMOVAL

If desired, steering knuckles may be removed from front axle without removing front axle as-

sembly from the vehicle. To remove steering knuckles from the axle either with or without removing the front axle assembly from vehicle, proceed as follows:

1. Remove cotter pins and nuts from tie rod end studs, then using a soft plastic hammer, tap studs until tie rod is loose; remove tie rod.

2. On vehicles equipped with mechanical steering, remove drag link from steering arm. On vehicles equipped with power steering, remove extension and end socket assembly from steering arm as directed in STEERING (SEC. 16) of this manual.

3. Remove front wheels, hubs, and bearings. Refer to HUBS, WHEELS, AND TIRES (SEC. 19).

4. Remove air brake mechanism and brake shoes. Detach brake shoe spider from knuckle and remove spider, camshaft, and slack adjuster as an assembly.

5. Remove nuts from steering tie rod arms and drive arms out of steering knuckles.

6. Remove cover (2, fig. 1) from top of knuckle to expose king pin nut. Remove snap ring from knuckle lower yoke and remove expansion plug.

7. Remove cotter pin, then remove nut from upper end of king pin. Using suitable brass drift, drive king pin downward out of axle and knuckle. Remove knuckle, thrust bearing, and spacing washer from axle. King pin bushing can be lifted out of knuckle upper yoke.

CLEANING

Wash steering knuckle parts in cleaning solution, being sure to remove all dirt and lubricant. If necessary, soak thrust bearings in cleaner until all old lubricant is dissolved; then slush bearing in cleaning solution until all grit is removed from races.

INSPECTION AND REPAIR

STEERING KNUCKLES

After steering knuckles have been cleaned, thoroughly examine knuckles for distortion, damage, cracks, or fractures. If Magna-Flux inspection equipment is available, use this method to inspect steering knuckles and king pins for minute cracks, checks, or fractures which otherwise would not be visible to the naked eye.

AXLE CENTER

There are two conditions which, if either exists, will necessitate replacement of axle center.

1. If king pin holes in axle center ends are worn to such an extent that a new pin fits loosely, axle center must be replaced.

2. If axle center has been twisted or bent more than 5 degrees from original shape, the center should be replaced. When an extreme bent condition exists, minute invisible fractures may occur and cause failure under ordinary operating conditions.

<u>Checking Axle Center</u>

Check axle center for twist with alignment instruments, or on a bench as illustrated in front end alignment chart (fig. 1 in "FRONT END ALIGNMENT" section). If equipment is available, use Magna-Flux method to check axle center for minute fractures.

<u>Straightening Axle Center</u>

The straightening of axle forgings must be performed by mechanics who are thoroughly familiar with such operations and use special straightening tools. After straightening, cold or hot, part must be heated to 900-1000°F. for two hours, then air-cooled.

THRUST BEARINGS

Examine thrust bearings for excessive wear, pitting, or other damage. If these conditions are evident or if bearing retainers are bent or damaged, bearings should be replaced.

BUSHING REPLACEMENT

Steering knuckle bushings should be replaced if inspection reveals that they are scored, worn, or otherwise damaged.

<u>Removal</u>

1. Clamp steering knuckle securely in vise equipped with soft jaws.

2. Thread tap of suitable size into bushing, if bushing driver is not available.

3. Using soft metal rod, slightly smaller than bushing and long enough to extend at least 1-1/2" through opposite knuckle yoke, drive tap and bushing out of knuckle bore.

4. Repeat process to remove remaining steering knuckle bushing.

<u>Installation</u>

1. Clean the steering knuckle bushing bores, then round off all sharp edges of new bushings slightly.

2. Position bushing so that oil hole in bushing will line up with lubrication fitting hole in steering knuckle yoke, and so that bushing will enter knuckle bore straight when pressed into yoke.

3. Using arbor press and suitable installer, press bushing into knuckle bore until positioned as shown in figure 2. NEVER ATTEMPT TO DRIVE BUSHINGS WITH HAMMER.

4. Ream or hone bushings to diameter given in "Specifications" at end of this section.

5. Clean cuttings out of oil grooves, then round off all sharp edges in grooves.

KING PIN

Check diameter of king pin at upper and lower bearing surfaces against dimensions given in "Specifications" at end of this section. If wear exceeds limits given, replace with new king pin.

King pins should also be inspected for minute cracks or other damage.

STEERING KNUCKLE INSTALLATION

The importance of cleanliness when assembling steering knuckle parts cannot be overstressed. If the king pins and bushings are installed with particles of dirt or metal between bearing surfaces, excessive wear will result necessitating premature replacement of parts.

Install steering knuckles and king pins in the following manner. Key numbers in text refer to figure 1.

1. Position steering knuckle (10) on axle center end (5), then slide thrust bearing assembly (9) into place between lower face of axle center and steering knuckle lower yoke. Make sure retainer is on top of bearing with lip of retainer down. Align king pin holes in steering knuckle yokes with king pin hole in axle center end.
2. With axle center held rigidly, place a jack under knuckle yoke and raise knuckle sufficiently to take up all clearance between lower yoke, thrust bearing, and lower face of axle center end.
3. Check clearance between top face of axle center end and lower face of steering knuckle yoke, then select shim and spacing washer combination which will reduce clearance to limits given in "Specifications" at end of this section. Shim and spacing washer thicknesses available are given in "Specifications" at end of this section.
4. Make certain king pin hole in axle center (5), king pin (6), and nut (1) are carefully cleaned and dry. King pin nut (1) should screw on king pin freely without binding in any manner. These precautions should be taken to assure king pin being securely locked in place when installation is completed.
5. Insert king pin (6) through bottom yoke of steering knuckle (10), then drive king pin into place with lead hammer.
6. Place king pin bushing (3) over threaded end of king pin (6), then press bushing into place. Be sure king pin bushing is installed squarely on king pin.
7. Make sure threads on king pin nut are clean and dry, then install king pin nut (1). Tighten nut with torque wrench to minimum torque given in "Specifications" at end of this section, then tighten nut until next castellation on nut lines up with cotter pin hole through king pin. Install new cotter pin, full size of cotter pin hole.
8. Position new cover gasket on steering knuckle upper yoke, place cover (2) on gasket, then secure cover with attaching screws.
9. Install new plug (7) in lower yoke, then install snap ring to retain plug. Install plug with concave side toward snap ring so edge of plug contacts ring.
10. Place keys in keyways in tie rod arms and steering arm and drive arms into tapered holes in knuckles. Install nuts and lock washers on arms and tighten nuts to torque specified in "Specifications" at end of this section. Secure nuts with cotter pins.
11. Install brake spider and camshaft assembly on knuckle, install brake chambers, and connect chamber push rods to slack adjusters. Install brake shoes, hubs and bearings, and brake drums. Refer to HUBS, WHEELS, AND TIRES (SEC. 19) for instructions for adjusting wheel bearings.
12. Install tie rod assembly, then on vehicles equipped with mechanical steering, connect drag link to steering arm; on vehicles equipped with power steering, connect extension and end socket assembly to steering arm as directed in STEERING (SEC. 16) of this manual.

TIE ROD

Tie rod assembly is three-piece tube comprised of a rod and two end assemblies. Tube is threaded into ends and locked with clamp bolts. Right- and left-hand threads are provided on tie rod to facilitate toe-in adjustment.

Tie rod ends (fig. 2) are constructed to automatically compensate for wear on bearing surfaces. Tie rod end stud is held in contact with bearing surfaces by tension of spring which holds seat firmly against inner end of stud. Tie rod end parts are held in place by a retaining plug and lock ring.

Normal wear on bearing surface in tie rod end will cause increase in overall height of assembly. If excessive play is noted, the parts which are worn must be replaced, or a new tie rod end assembly must be installed.

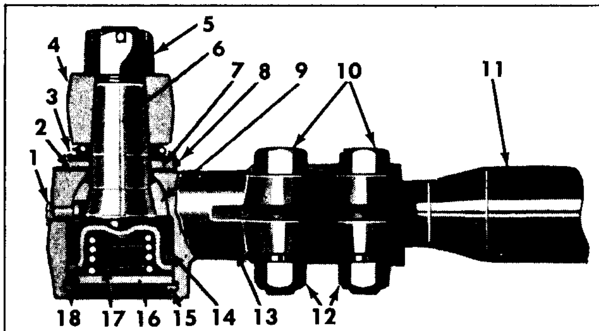
TIE ROD REMOVAL AND DISASSEMBLY (Fig. 2)

1. Remove cotter pins and nuts from tie rod ends (13), support steering arm to prevent bending, then drive tie rod end tapered stud (6) out of steering arm. Remove spring (3), dust seal retainer (8), seal (7), and washer (2) from stud.
2. Loosen clamp bolts (10), then remove tie rod end assembly from tie rod (11).
3. Pry end plug lock ring (15) out of groove in end (13); then remove plug (16), seat and spring (17 and 18), and grease seal (14). Stud (6) and bearing (9) assembly can now be removed from body.

INSPECTION

Clean all parts of tie rod and then inspect

FRONT AXLE REPAIR



1 Dowel Pin
2 Dust Seal Washer
3 Dust Seal Spring
4 Steering Arm
5 Stud Nut
6 Stud
7 Dust Seal
8 Dust Seal Retainer
9 Stud Bearing
10 Clamp Bolt
11 Tie Rod
12 Bolt Nut
13 Tie Rod End
14 Grease Seal
15 Lock Ring
16 Retaining Plug
17 Seat Spring
18 Spring Seat TPM-7753

Figure 2—Tie Rod End

parts for wear and check tension of spring (17, fig. 2). Discard worn parts and replace spring if broken or weak.

TIE ROD ASSEMBLY AND INSTALLATION (Fig. 2)

1. Lubricate parts with lubricant specified in LUBRICATION (SEC. 13) before assembling tie rod ends.
2. Insert end stud (6) and bearing (9) into tie rod end (13). Place grease seal (14) over end of spring seat (18); position seat in tie rod end (13).
3. Place stud seat spring (17) inside seat (18), lay retaining plug (16) on spring, then compress spring (17) and install lock ring (15) in groove in tie rod end (13).
4. Thread tie rod end assemblies on tie rod (11), install clamp bolts (10), new lock washers and nuts (12). Do not tighten nuts (12) at this time.
5. Carefully clean tapered portion of tie rod end studs (6), then install dust seal washer (2), dust seal (7), dust seal retainer (8), and dust seal spring (3) on end studs in order named.
6. Clean tapered holes in steering tie rod arms, position complete tie rod assembly on steering arms, then thread stud nut (5) on end stud (6). Tighten stud nuts to minimum torque given in "Specifications" at end of this section, then tighten nuts until next castellation on nut lines up with cotter pin holes in studs. Install new cotter pin full size of hole.

FRONT AXLE SPECIFICATIONS

STEERING KNUCKLE	
Spindle Diameter	
At Inner Wheel Bearing	2.5613"-2.5623"
At Outer Wheel Bearing	2.1243"-2.1248"
Steering Knuckle Bushings	
Inner Diameter	1.7965"-1.7975"
Length	2.1775"-2.1975"
King Pin Bushings	
Inner Diameter	1.310"-1.311"
Outer Diameter	1.7930"-1.7940"
Length	2$\frac{15}{32}$"
KING PIN	
Diameter at Top of Pin	1.3085"-1.3095"
Diameter at Bottom of Pin	1.7930"-1.7940"
Length (Overall)	10¾"
FITS AND TOLERANCES	
Clearance Between	
King Pin Bushing and Knuckle Bushing	0.0025"-0.0045"
King Pin and Lower Knuckle Bushing	0.0025"-0.0045"
King Pin and King Pin Bushing	0.001"-0.003"

FITS AND TOLERANCES (Cont.)	
Steering Knuckle Thrust	0.015" Maximum
Thrust Adjustment	With Shims and Spacers
Shim Thickness Available—1 @	0.015"
Spacing Washer Thickness Available	0.093", 0.125", & 0.156"
TORQUE SPECIFICATIONS	
King Pin Nuts	350-390 ft.-lbs.
Steering Arm Nuts	350-390 ft.-lbs.
Tie Rod End Clamp Bolt Nuts	45-55 ft.-lbs.
Tie Rod End Stud Nuts	150 ft.-lbs. min., then advance to nearest cotter pin hole
TIE ROD END	
End Stud Seat Spring Free Length	1¼"
Resistance When Compressed to ⅞"	225-275 lbs.
Solid Height	$\frac{13}{16}$"
AXLE CENTER	
Maximum Allowable Twist End to End	½°

Rear Axle

DESCRIPTION

Rear axle is full-floating type, using a one-piece axle housing with housing bowl cover welded to housing. Housing bowl is located to the left of axle center line.

As shown in figure 1, drive pinion assembly is mounted at an angle to drive gear, thus increasing the tooth contact area between drive gear and drive pinion gear teeth. Drive is transmitted from transmission angle drive unit through propeller shaft to spiral bevel gears, axle housing, and then to vehicle underframe through upper and lower radius rods.

Differential and drive pinion assemblies are both provided with facilities for adjustment of bearings and gear tooth contact.

DIFFERENTIAL CARRIER

Differential assembly, drive pinion, and pinion cage assembly are mounted in differential carrier. After axle shafts have been removed and propeller shaft has been disconnected, differential carrier can be removed for inspection and adjustment without removing axle housing from vehicle.

DIFFERENTIAL ASSEMBLY

Conventional four-pinion type differential is carried in two-piece case mounted on tapered roller bearings. Bevel drive gear is bolted to flanged half of differential case. Drive gear and pinion are furnished in matched, lapped sets, and should always be installed as such to assure satisfactory operation.

Thrust washers are used between differential side gears and case, also between differential pinions and case. Differential case halves are held together with special bolts and slotted nuts, locked in place with lock wire.

DIFFERENTIAL SIDE BEARINGS

Differential is supported in tapered roller bearings which take thrust as well as radial loads. Bearings are mounted in machined supports in differential carrier, with thrust loads taken by adjusting rings threaded into carrier supports and bearing caps. Adjusting rings bear against bearing cups and are locked in position by adjusting ring locks bolted to each bearing cap.

PINION AND CAGE ASSEMBLY

Bevel drive pinion is installed at an angle in differential carrier. Pinion is straddle mounted in two opposed tapered roller bearings at outer end, and one straight roller bearing at inner end.

Tapered roller bearing cups installed in pinion cage are separated by a machined shoulder in pinion cage.

Pinion bearings are adjusted on shaft by selecting a spacer of correct thickness as described later in this section under "Drive Pinion and Cage Assembly."

Straight roller bearing at inner end of drive pinion is secured in place with a retainer ring.

Shims of various thicknesses are used between pinion cage and differential carrier to adjust drive pinion tooth contact and gear backlash.

Pinion shaft and cage assembly cannot be removed from carrier until differential assembly has been removed from carrier.

AXLE SHAFTS AND HOUSING

Axle shafts are full floating type. Drive flange at outer end is attached to hub by studs, nuts, and tapered dowels; inner end of shaft is splined to differential side gear.

Axle housing is one-piece design with differential located off center. Housing is equipped with outer end tubes which are threaded to accommodate wheel bearing adjusting nuts.

MAINTENANCE ON VEHICLE

The following maintenance operations should be accomplished at regular inspection and lubrication intervals.

LUBRICATION

Lubrication checking and draining intervals and filling instructions, also type of lubricant and capacity is given in LUBRICATION (SEC. 13).

Examine pinion oil seal, axle shaft flange and carrier to housing gaskets for evidence of lubricant leakage. Tighten bolts or nuts, or replace gaskets and seals to correct leaks.

MOUNTING

Maintenance of axle mounting on vehicle consists primarily of a regular and systematic inspection of air suspension units and radius rods as directed in AIR SUSPENSION (SEC. 14).

REAR AXLE

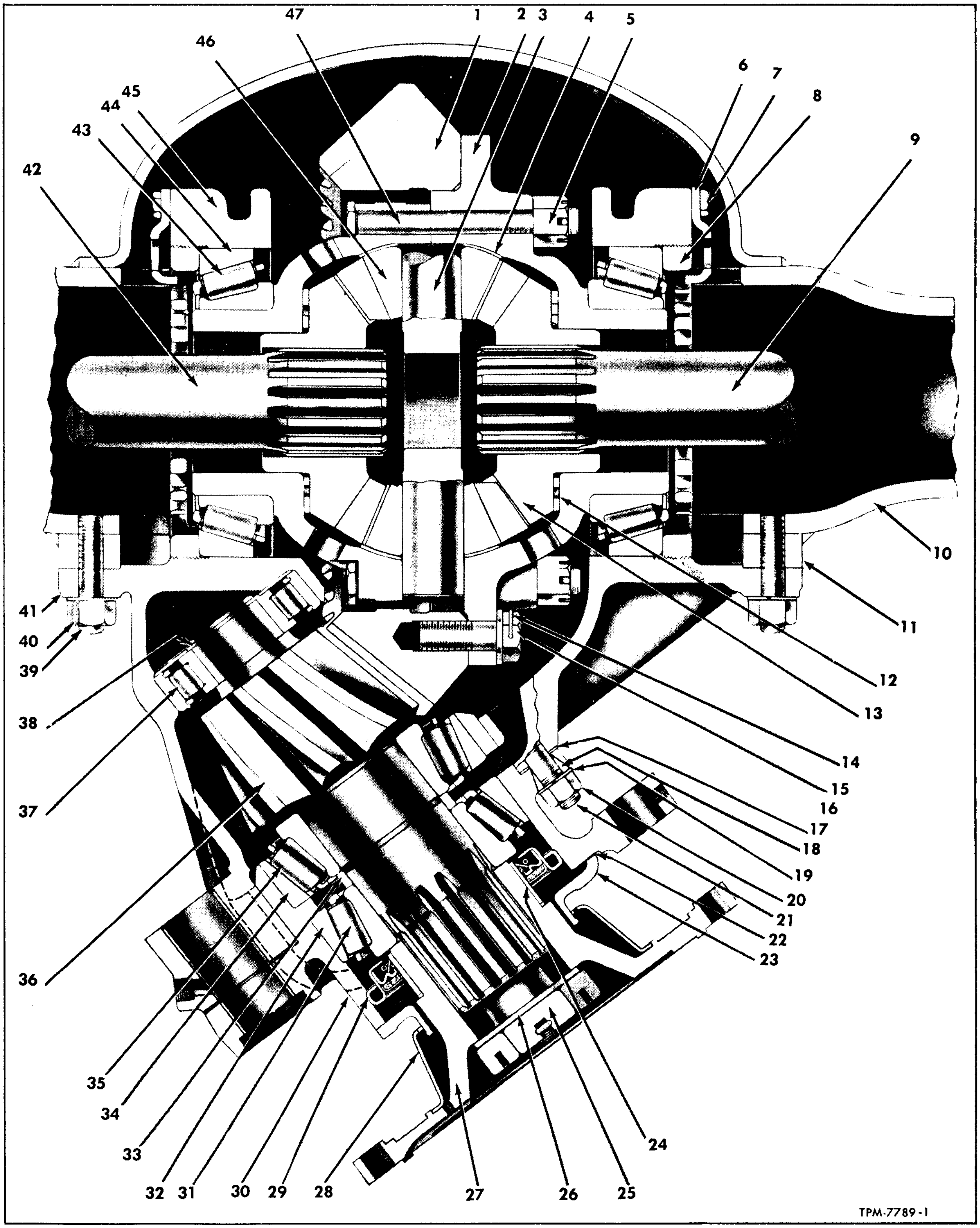


Figure 1—Sectional View of Rear Axle

1 Drive Gear	18 Pinion Cage Tapered Dowel	33 Pinion Bearing Spacer
2 Differential Case	19 Lock Washer	34 Pinion Bearing Cup - Inner
3 Differential Spider	20 Stud Nut	35 Pinion Bearing Cone - Inner
4 Pinion Thrust Washer	21 Pinion Cage Stud	36 Drive Pinion
5 Case Bolt Nut	22 Pinion Oil Seal Retainer Gasket	37 Pinion Bearing
6 Adjusting Ring Lock	23 Pinion Oil Seal Retainer	38 Bearing Retainer Ring
7 Lock Bolt	24 Oil Seal Sleeve	39 Carrier Stud
8 Bearing Adjusting Ring	25 Pinion Nut	40 Stud Nut
9 Axle Shaft (Right)	26 Pinion Nut Washer	41 Lock Washer
10 Axle Housing	27 Propeller Shaft Companion Flange	42 Axle Shaft (Left)
11 Carrier Gasket	28 Dust Slinger	43 Differential Bearing Cone
12 Side Gear Thrust Washer	29 Pinion Oil Seal Assembly	44 Differential Bearing Cup
13 Differential Side Gear	30 Pinion Cage	45 Differential Bearing Cap
14 Bolt Lock Wire	31 Pinion Bearing Cone - Outer	46 Differential Pinion
15 Drive Gear Bolt	32 Pinion Bearing Cup - Outer	47 Differential Case Bolt
16 Differential Carrier		
17 Pinion Cage Shims		

Captions for Figure 1—Opposite Page

AXLE SHAFT AND PINION CAGE MOUNTING

Axle shafts and pinion cage are retained with stud nuts, lock washers, and split tapered dowels. The studs must be straight and dowels of correct taper must be used. There should always be a slight clearance between nuts and mounting flange when nuts are tight.

Whenever inspection shows that no clearance exists between nut and flange, this indicates that excessive wear exists at tapered dowels, studs, or tapered holes in drive flange.

If stud nuts are not tightened to recommended torque, play at flange and broken or worn studs will result and damaged parts must be replaced.

REAR AXLE REPLACEMENT

Complete instructions for removal and installation of rear axle assembly will be found in AIR SUSPENSION (SEC. 14).

DIFFERENTIAL CARRIER REPLACEMENT
(WITH AXLE IN VEHICLE)

Due to limited space between rear axle and bulkhead, the following procedures are necessary to remove and install the differential carrier with axle installed under vehicle.

REMOVAL

1. Place rear wheels of coach on 10-inch riser blocks. Block front wheels securely to prevent vehicle rolling.
2. Remove axle shafts as previously directed under "Axle Shaft Replacement" in this section.
3. Remove drain plug and drain lubricant from axle housing.
4. Disconnect parking brake control rod and link from bellcrank on top of differential carrier. Remove bellcrank from stud in carrier.
5. Disconnect propeller shaft universal joint from flange yoke at axle, referring to PROPELLER SHAFT (SEC. 18) in this manual.
6. Remove nut from bolt attaching each rear height control valve link to bracket at bellows support. Disengage link bolt from bracket.
7. Pull down on both height control valve levers to exhaust air pressure from rear suspension bellows until axle bumpers rest on axle.
8. With body lowered as in step 7, propeller shaft can be removed. To remove shaft, unscrew dust cap from slip yoke at transmission end of shaft, then withdraw shaft out of slip yoke and remove from under vehicle.
9. Lift up on both height control valve levers to admit air pressure into the rear suspension bellows. Hold levers up until coach body has raised sufficiently to permit installing a 10-inch safety spacer between body and axle at each side. Spacers can be made from steel tubing of sufficient diameter to fit over the axle bumpers. After installing safety spacers, pull down on both height control valve levers to exhaust air pressure from bellows, permitting coach body to rest on safety spacers.

Hold levers down until all air pressure is exhausted from bellows.

10. Remove nuts from two studs attaching right-hand rear bellows piston to suspension support. Block bellows away from cut-out in inner side of support to permit removal of parking brake drum.

11. Remove nuts and lock washers attaching parking brake drum to drive pinion companion flange. Remove drum from flange.

12. Remove lock wires, bolts, and lock washers attaching universal joint flange yoke to drive pinion companion flange. Remove flange yoke.

13. Remove parking brake drum studs from drive pinion companion flange, using a suitable stud remover to prevent damaging threads.

14. Remove nuts and lock washers from studs attaching differential carrier to axle housing. Remove the four lower studs from housing, using a suitable stud remover.

15. Loosen lock nuts on two carrier-to-housing pusher screws. Turn screws in to start carrier out of housing.

16. Position a dolly jack under differential carrier and raise into position to support carrier. Jack should have a suitable bowl-type adapter which will support carrier and prevent tipping.

17. As carrier is moved out of housing, move it down and to the left as necessary to clear obstructions.

NOTE: Differential carrier overhaul is covered later in this section under "Axle Overhaul."

INSTALLATION

1. Make sure the carrier-to-housing pusher screws are backed out so ends of screws will not interfere with carrier-to-housing contact. Secure screws with lock nuts.

2. Clean mating surfaces of carrier flange and axle housing. Position a new gasket over studs in axle housing.

3. With carrier securely supported on a dolly jack, position under vehicle and raise into position at axle housing. Start carrier into housing until studs extend through carrier flange. Use flat washers and nuts on four evenly spaced studs to draw carrier squarely into housing.

4. Install the four lower studs which were removed prior to removal of carrier. Seat studs firmly, using a suitable stud replacer.

5. Remove nuts and flat washers used to draw carrier into position, then install lock washers and nuts on all studs. Tighten nuts to 285-365 foot-pounds torque.

6. Install parking brake drum studs in drive pinion companion flange.

7. Install universal joint flange yoke on drive pinion companion flange and attach with bolts, lock washers, and nuts. Nuts must be on axle side of companion flange, with the lock washers under the bolt heads. Tighten firmly, then thread lock wires through adjacent pairs of bolt heads and twist ends of each wire together.

8. Install parking brake drum over studs in drive pinion companion flange and attach with lock washers and nuts. Tighten nuts firmly.

9. Install bellcrank on stud on top of carrier. Connect adjustable lever link and parking brake control rod to bellcrank.

10. Position right-hand rear bellows piston on suspension support with two studs in piston extending down through holes in support. Install self-locking nuts on studs and tighten firmly.

11. Push up on both height control valve levers to admit air pressure into bellows. Hold levers up until coach body has risen enough to permit removal of safety spacers. Remove spacers.

12. Pull down on both height control valve levers to exhaust air pressure from bellows, permitting coach body to lower until axle bumpers rest on axle. (This is necessary to provide clearance for installing propeller shaft.)

13. Insert the splined end of propeller shaft through opening in bulkhead and insert into slip yoke at transmission, making sure alignment arrows on slip yoke and shaft are aligned. Thread dust cap onto slip yoke and tighten with hand.

14. Connect propeller shaft to flange yoke at axle by assembling universal joint as directed in PROPELLER SHAFT (SEC. 18).

15. Insert the height control valve link bolts through holes in brackets and secure with self-locking nuts. Tighten nuts firmly.

16. Install drain plug in axle housing and tighten firmly. Fill axle housing with lubricant, and lubricate propeller shaft universal joints and parking brake bellcrank as directed in LUBRICATION (SEC. 13).

17. Adjust parking brake linkage as directed in "PARKING BRAKE" (SEC. 4).

18. Install axle shafts as directed under "Axle Shaft Replacement" in this section.

AXLE SHAFT REPLACEMENT

The following procedures for removal and installation of axle shaft is applicable regardless whether the axle assembly is removed or installed on the vehicle.

REMOVAL

1. Remove nuts and washers from hub studs.

2. Strike center of flange with a lead hammer to loosen flange and dowels from studs.

3. Withdraw axle shaft from housing, then remove gasket from hub or flange.

NOTE: Three threaded holes are provided in axle shaft flange for use of puller screws, if necessary.

INSTALLATION

1. Before installing axle shafts, hubs should be removed and bearings cleaned, inspected, and adjusted as directed in "HUBS AND BEARINGS" (SEC. 19).

2. Install new gasket over hub studs. NOTE: Observe that oil seal wiper is in place on outer end of axle housing tube and oil seal assembly is in place on hub studs.

3. Dip splined end of axle shaft in rear axle lubricant, then insert shaft into housing, guiding shaft into side gear and at same time align flange holes with hub studs. When studs and flange holes are in alignment, push axle shaft into place.

4. Install split tapered dowels, external-toothed lock washers, and nuts on four studs at tapered holes in flange; also install lock washers and nuts at remaining six studs. Tighten nuts alternately and evenly to 75-100 foot-pounds torque.

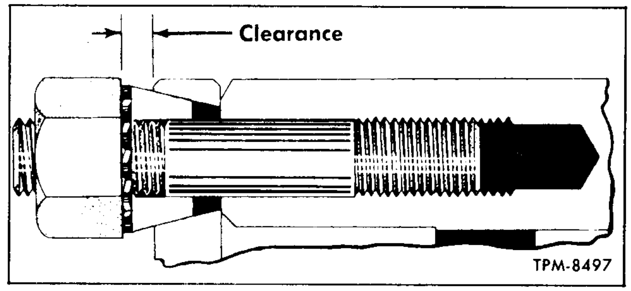


Figure 2—Clearance Between Nut and Flange

5. Observe that clearance exists between nut and flange (fig. 2). If no clearance exists, this indicates excessive wear at studs, dowels, or flange holes. Replace worn parts if necessary.

OVERHAUL

DISASSEMBLY

Rear axle may be disassembled while the housing remains installed in vehicle if proper equipment is available for handling differential assembly. Information on suspension, propeller shaft, brakes, hubs, bearings, wheels, and tires will be found in respective sections of this manual.

The following instructions provide procedures for complete disassembly, cleaning, inspection, repair, and reassembly of rear axle. Axle housing may be checked for bent condition before axle assembly is removed from coach. The following repair procedure is based on the operations necessary when axle is removed from coach.

Before and during disassembly operations, perform following inspections and check all adjustments to determine repairs required.

Key numbers in text refer to figure 1 unless otherwise indicated.

AXLE HOUSING CHECK

At regular inspection intervals, or if conditions indicate that rear axle housing might be bent, housing should be checked, using the following method. This check can be made before or after axle is removed from coach to determine if axle housing is sprung. Conventional camber and toe-in gauges can be used to perform inspection.

1. Support axle in level position using blocks at each support beam; then check rear wheel bearings for proper adjustment as instructed in "HUBS AND BEARINGS" (SEC. 19).

2. Check run-out at each rear wheel and replace wheels having run-out in excess of 3/32".

3. Check for toe-in and camber at rear wheels. Rear wheels should not toe-in or out more than 1/8", and camber should be zero, plus or minus 1/4 degree. If measurements are not within the above dimensions, bent or sprung axle housing is indicated. Make notation of the existing conditions for use when making corrections later.

4. In cases where bent axle housings are indicated, further checks to determine exact location of bend should be made after differential carrier has been removed, then necessary steps taken to correct the condition.

DIFFERENTIAL CARRIER REMOVAL

1. Remove axle shafts as previously instructed under "Axle Shaft Replacement" in this section.

2. Remove stud nuts and lock washers attaching brake drum to propeller shaft flange, then remove brake drum.

3. Remove drain plug and drain lubricant from housing.

4. Remove cotter pin and clevis pin attaching link to adjustable lever on hand brake camshaft. Remove lock wire, lock nut, washer, and dust shield attaching hand brake bellcrank on stud, then remove bellcrank and link as an assembly.

5. Remove stud nuts (40) and lock washers (41) from differential carrier studs (39).

6. Be certain that differential carrier is supported securely, then proceed to pull complete carrier assembly out of housing. A small pinch bar may be used to keep carrier straight in housing

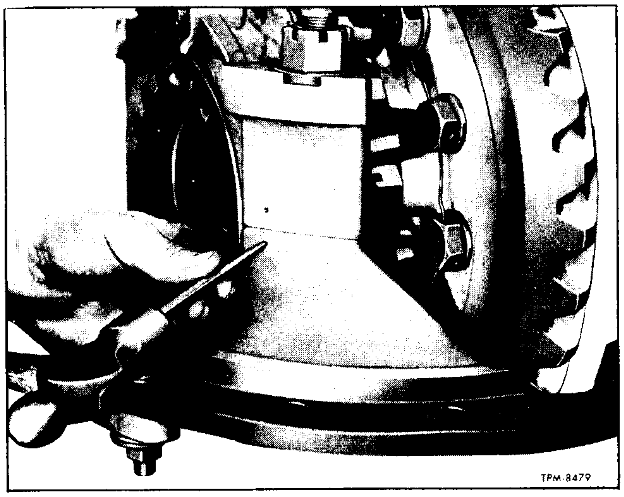


Figure 3—Bearing Cap Alignment Marks

bore while carrier is being withdrawn, provided end of bar is rounded to prevent damage to carrier flange.

DIFFERENTIAL REMOVAL

1. Remove lock wire from adjusting ring lock retaining bolts (7), then remove locks (6).
2. Remove wires and nuts from differential side bearing cap studs. Make certain that bearing caps (45) and carrier are marked (fig. 3) before removal, then remove side bearing caps (45). Remove side bearing adjusting rings (8). Lift differential assembly with cups (44) from carrier. Remove bearing cups (44) from bearings.

DIFFERENTIAL DISASSEMBLY

1. Mark both halves of differential case (2) so halves may be reassembled in original positions (fig. 4).

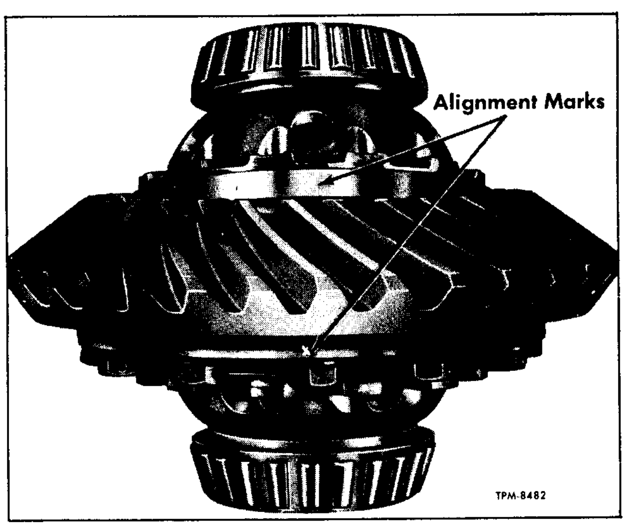


Figure 4—Differential Case Alignment Marks

2. Remove lock wire and nuts (5) from bolts (47) which hold the two halves of differential case (2) together; then separate halves of case.
3. Remove side gears (13), thrust washers (12), spider (3), pinions (46), and thrust washers (4) from differential case.
4. Using differential bearing remover plug (J-4856) as shown in figure 5, drive bearing evenly off each differential case half, using a long punch and hammer as illustrated.
5. Remove lock wire from cap screws, then remove cap screws holding drive gear to differential case. Remove gear from case.
6. If either drive gear (1) or drive pinion (36) are worn or damaged, both must be replaced as a matched set. Never replace drive pinion or drive gear separately.

PINION CAGE REMOVAL
AND DISASSEMBLY

1. Remove parking brake shoes as directed in "PARKING BRAKE" (SEC. 4).
2. Remove nuts (20) and lock washers (19) which secure pinion cage (30) to differential carrier (16). Tap pinion cage to loosen and remove four tapered dowels.
3. Install two puller screws (1/2"-13 x 1-1/2") and tighten alternately and evenly to pull cage (30) out of carrier. Remove shim pack (17) from pinion cage studs (21). Tie shims (17) together so same shim pack may be used at reassembly.
4. Remove retainer ring (38) which secures

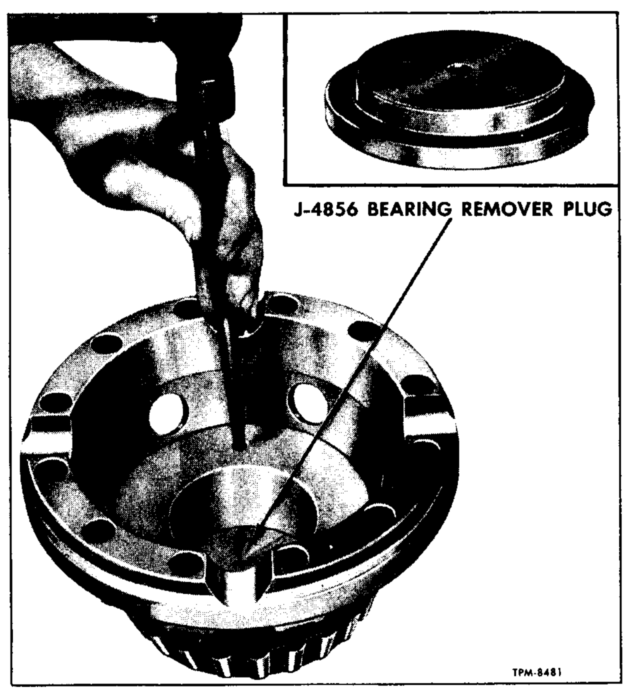


Figure 5—Differential Bearing Removal

inner bearing (37) on drive pinion (36); then remove inner bearing from drive pinion using universal puller (J-8176) and arbor press in manner illustrated in figure 6.

5. Clamp pinion in vise equipped with soft jaw plates. Remove cotter pin, nut (25), and washer (26) from drive pinion (36).

6. Using suitable puller, remove propeller shaft companion flange (27) from drive pinion (36).

7. Remove cap screws and lock washers from pinion oil seal retainer (23), then remove retainer and gasket. Remove parking brake camshaft from brake spider.

8. Place cage and drive pinion assembly in an arbor press and press drive pinion (36) out of flange (27) and pinion cage. Outer bearing (30) will remain in pinion cage.

9. Remove bearing adjusting spacer (33) from drive pinion (36) and tag for reassembly reference.

10. If necessary, inner bearing cone (31) can be removed from pinion with universal puller (J-8176) and arbor press as illustrated in figure 6.

11. Remove oil seal (29) assembly from pinion cage.

12. When inspection indicates necessity, cups (32 and 34) can be removed from cage, using remover (J-3940) in manner illustrated in figure 7.

CLEANING, INSPECTION, AND REPAIR

CLEANING BEARINGS

The importance of proper bearing cleaning cannot be over-emphasized. Bearings should always be cleaned separately from other rear axle parts. When cleaning bearings, be sure to perform all of the following steps:

1. Soak differential and drive pinion bearings in clean kerosene, Diesel fuel oil, or other cleaning solvent. Gasoline should not be used as a bearing cleaner. Also, bearings should never be placed in a hot solution tank for cleaning.

2. After old lubricant is loosened, hold bearing races so that bearings cannot rotate, then brush bearings with soft bristled brush until all grit and dirt has been removed.

3. Rinse bearings in clean fluid; then, while holding races, blow dry with compressed air. Be sure air stream is moisture free.

4. Inspect bearings as instructed under "Inspection Operations" later in this section. If bearings pass inspection, dip bearings in differential lubricant recommended in LUBRICATION (SEC. 13); then wrap bearings in clean cloth or paper until ready to reassemble axle.

CLEANING PARTS

Immerse all parts in suitable cleaning fluid and clean parts thoroughly. Use a stiff bristle brush to remove all old lubricant. Remove par-

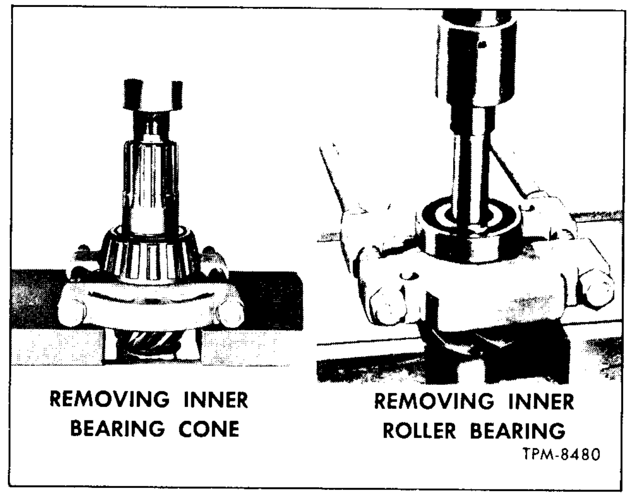


Figure 6—Pinion Bearing Removal

ticles of gaskets which may adhere to mating faces of axle housing, differential carrier, hubs, and axle shaft flanges. Clean out lubricant channels in pinion cage and differential carrier. Clean housing breather. Make certain that interior of axle housing is thoroughly cleaned.

INSPECTION

Whenever available, the Magna-Flux method should be used on all steel parts, except ball and roller bearings. This method is especially suited

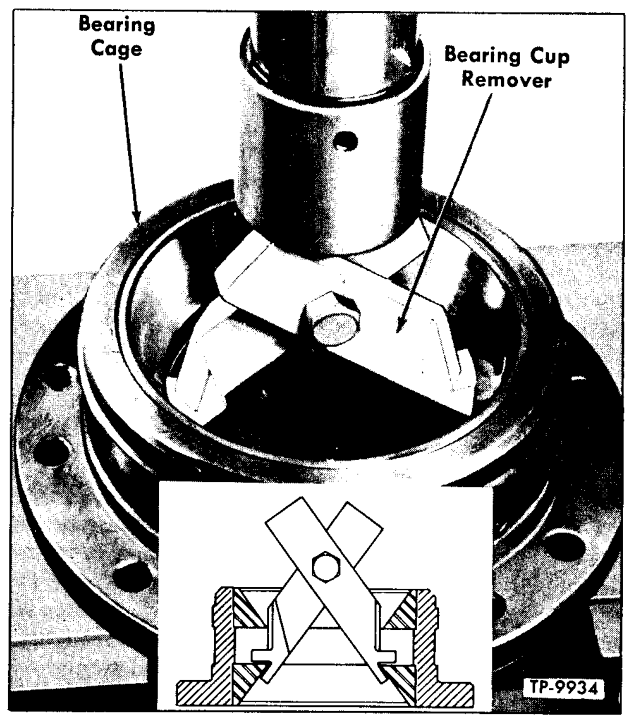


Figure 7—Pinion Cage Bearing Cap Removal

REAR AXLE

for inspection of ground or highly finished surfaces for wear and cracks which otherwise would not be visible.

INSPECTION OPERATIONS

1. Bearings. Rotate each bearing slowly, and at the same time examine bearing for roughness, damage, defects, or wear. Note condition of bearing cage. Replace bearing if cage is damaged or if any of the conditions previously noted exist.

2. Gears. Examine drive gear, drive pinion, and differential gears for damaged teeth, worn spots in surface hardening, and distortion. Check differential pinions for excessive wear, and fit on spider. Refer to "Specifications" at end of this section for limits. Check radial clearances between differential side gear hubs and differential case.

3. Differential Case. Inspect differential case assembly for cracks, distortion, or damage. If case is in good condition, thoroughly clean case and cover; then assemble case with bolts and mount in lathe centers or "V" block stand. If lathe is not available, install differential side bearings and mount case in differential carrier as directed under "Differential Assembly Installation" later in this section. Install dial indicator and check differential case run-out. Refer to "Specifications" at end of this section for run-out limits. Whenever run-out exceeds limits, differential case run-out may be corrected as later described under "Repair" in this section.

4. Axle Shafts. Examine splined end of axle shaft for twisted or cracked splines, twisted shaft, or damaged flange. If any of above conditions are evident, install new axle shafts.

5. Axle Shaft and Flange Run-Out. Install axle shaft assembly in lathe centers or "V" blocks. Check shaft run-out with dial indicator; if run-out exceeds limits listed in "Specifications" at end of this section, discard axle shaft. Position dial indicator so that indicator shaft end contacts inner surface of flange near outer edge, then check flange run-out. If run-out exceeds limits listed in "Specifications" at end of this section, discard axle shaft.

AXLE HOUSING INSPECTION

If check made prior to disassembly of axle indicated a bent condition at axle housing, make more complete check of housing on surface plate and after locating point at which housing is bent, the housing may be straightened if equipment is available. The straightening of axle forgings must be performed by mechanics who are thoroughly familiar with such operations, and special straightening tools must be used. After straightening, cold or hot, part must be heated to 900-1000°F. for two hours, then air-cooled.

OIL SEAL INSPECTION

Replacement of oil seal when unit is disassembled is more economical than premature overhaul to replace this part at a future time. Further loss of lubricant through a worn seal may result in failure of other parts, such as gears and bearings.

Handle seal carefully, particularly when being installed. Cutting, scratching or curling under of lip of seal seriously impairs efficiency of seal. Use of Permatex or equivalent around outer diameter of seal is recommended to insure against leakage at that point.

OIL SEAL SLEEVE

Carefully inspect oil seal sleeve at propeller shaft companion flange for any pitted, corroded, or worn condition at oil seal contact surface. If such imperfections cannot be cleaned up by polishing, the sleeve must be replaced.

REPAIR

Differential Case. Excessive run-out on differential case may be corrected by machining flange on gear side of case. Remove sufficient metal from flange to correct excessive run-out. Metal must be cut on a true plane, removing just enough metal to bring run-out within limits listed in "Specifications" at end of this section. After differential case has been machined, remove burrs and clean case assembly thoroughly.

Propeller Shaft Flange Sleeve. Whenever inspection indicates that oil seal contact surface of sleeve on propeller shaft flange is corroded or pitted, the condition may be corrected by cleaning and polishing surface with a suitable abrasive cloth. If cleaning and polishing surface of sleeve does not clear up the condition, remove sleeve and install new part.

AXLE ASSEMBLY

After all parts have been thoroughly cleaned, apply a thin coating of differential lubricant, as specified in LUBRICATION (SEC. 13), on all thrust and bearing surfaces. Coating parts will prevent scoring when vehicle is first placed in service.

Use of new lock washers, gaskets, and oil seals is recommended during assembly of axle.

All adjustments given in assembly procedures must be made carefully to insure efficient and continuous axle operation.

Key numbers in text refer to figure 1 unless otherwise indicated.

DRIVE PINION AND CAGE ASSEMBLY

1. If pinion bearing cups (32 and 34) were removed during disassembly, press bearing cups firmly against shoulder of pinion bearing cage.

2. Position pinion bearing (35) on drive pinion (36), with widest part of bearing cone toward gear teeth, then press bearing on pinion until bearing cone is seated solidly on drive pinion.

3. Install drive pinion inner bearing (37) on drive pinion (36), using arbor press. Install retainer ring (38) to retain bearing.

4. Lubricate pinion bearing cones and cups. Install original pinion bearing adjusting spacer (33) on drive pinion.

5. Insert drive pinion (36) and bearing assembly into pinion cage (30); then using an arbor press, press outer pinion bearing (31) firmly against bearing spacer (33). Rotate bearing cage through several complete revolutions to assure normal bearing contact.

6. While assembly is still in press under pressure (14-ton), check drive pinion bearing preload. Wrap soft wire around pinion bearing cage (30) as shown in figure 8. Attach pound scale to wire, then pull on scale, keeping scale in a horizontal plane. Note scale reading when assembly is rotating freely. Reading should be from 5 to 15 inch-pounds. To compute inch-pound value of scale reading, multiply scale reading (pounds) by one-half pinion cage diameter (inches). If reading does not fall between limits given, use thinner spacer (33) to increase or thicker spacer to decrease pinion bearing preload. Spacer thicknesses available are given in "Specifications" at end of this section.

NOTE: If arbor press is not available, temporarily install propeller shaft flange (27), washer (26), and nut (25). Tighten nut to 800-1100 foot-pounds torque, then check pinion bearing preload as directed in preceding paragraph. Remove nut, washer, and flange after adjustment.

7. Lubricate oil seal assembly (29) and cover outer edge of seal body with a non-hardening sealing compound; then install oil seal in cage, being careful that it is straight and is seated against shoulder in cage.

8. Install oil slinger to cage, using new gasket. Install and tighten cap screws.

9. Install parking brake camshaft in brake spider.

10. Using arbor press, press propeller shaft companion flange onto drive pinion.

11. Place washer (26) on drive pinion (36), then install nut (25). Tighten nut to minimum torque of 800 foot-pounds, then tighten nut until next castellation on nut lines up with cotter pin hole in drive pinion and install cotter pin.

DRIVE PINION INSTALLATION

1. Lubricate drive pinion bearings with rear axle lubricant recommended in LUBRICATION (SEC. 13).

2. Place original pinion cage shims (17) over

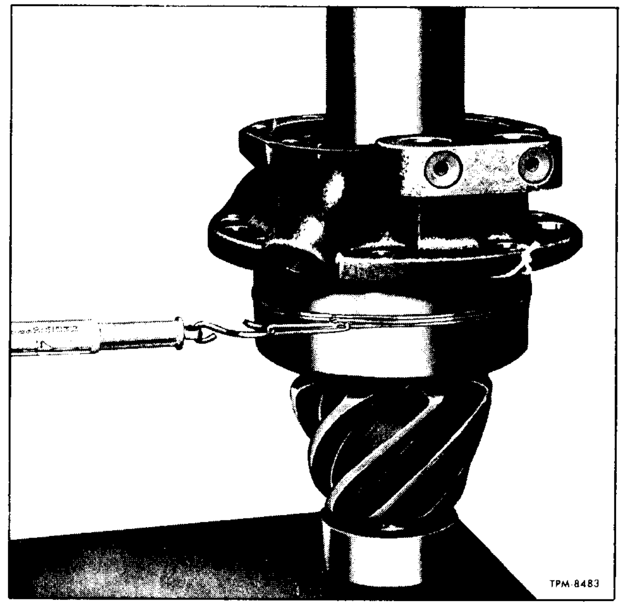


Figure 8—Checking Pinion Bearing Preload

pinion cage studs (21), then position drive pinion and cage assembly on studs (21). IMPORTANT: Oil holes in shims must line up with oil passages in differential carrier and cage when installed, to assure proper lubrication of drive pinion bearings (31 and 35).

3. Install new split tapered dowels (18), external-toothed lock washers, and nuts at four studs, also lock washer and nut (20) at four remaining studs. Tighten nuts (19) to 95-100 foot-pounds torque.

4. Install parking brake shoes as directed in "PARKING BRAKE" (SEC. 4) of this manual.

DIFFERENTIAL ASSEMBLY

After checking differential case run-out as previously described under "Cleaning, Inspection, and Repair" in this section, assemble differential as follows:

1. Lubricate differential case inner walls and all component parts of differential assembly with rear axle lubricant specified in LUBRICATION (SEC. 13).

2. Using an arbor press, press differential bearing cones on differential case, making sure cones seat firmly against shoulder of case.

3. Using alignment marks that were made at disassembly, position flanged side of differential case on bevel gear. Install washers and bolts, and tighten bolts to 255-280 foot-pounds torque. Install lock wire in such a manner that lock wire will become tighter if bolts should work loose.

4. Position side gear thrust washer (12) on hub of side gear (13), then place gear in flanged half of differential case (2).

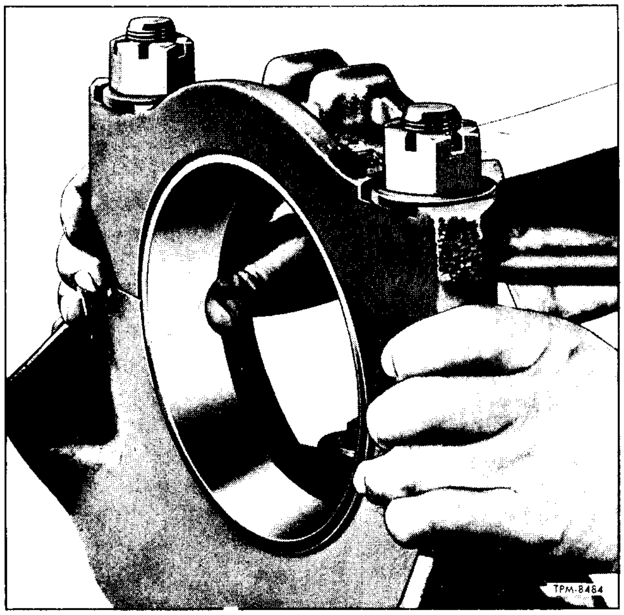


Figure 9—Checking Fit of Differential Bearing Cup

5. Lay flanged half of case on bench with flange upward, place differential pinions (46) and pinion thrust washers (4) on differential spider (3), place pinion and spider assembly on side gear (13) previously installed, then install remaining side gear (13) and thrust washer (12).

6. Place plain half of differential case on opposite half, with alignment marks positioned as shown in figure 4. Install case bolts (48) downward through both halves of case.

7. Install nuts (5) on four equally spaced bolts (48), and tighten to torque of 185-205 foot-pounds. Check assembly for free rotation. If rotation is free and smooth, install remaining bolts and nuts and tighten to recommended torque.

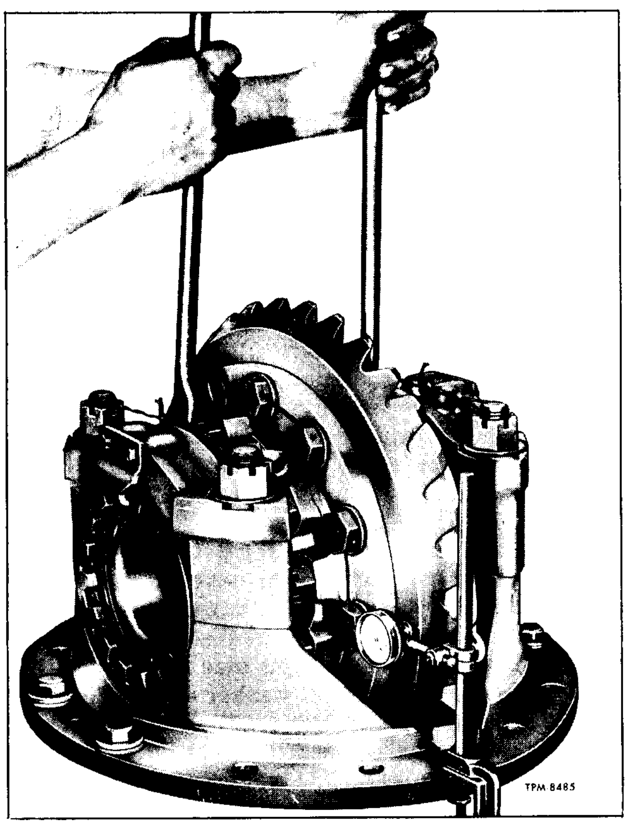


Figure 10—Differential Bearing Preload Check

DIFFERENTIAL ASSEMBLY INSTALLATION

Proper bearing cup and adjusting ring fit is of utmost importance and should be carefully checked before differential is installed.

1. Temporarily install bearing cup, adjuster ring, and bearing cap, then tighten stud nuts to recommended torque.

2. Bearing cup must be a hand push fit (fig. 9) in bore, otherwise the bore must be reworked with a scraper or emery cloth until proper fit is obtained. Location of high spots in carrier bore can be readily located by applying a light coating of prussian blue to bearing cup.

3. If adjusting ring cannot be turned by hand or with a maximum of 20 foot-pounds torque, this indicates that ring may be oversize and another ring that provides proper fit should be used.

4. Coat differential side bearing cones and cups with rear axle lubricant specified in LUBRICATION (SEC. 13).

5. Place bearing cups (44) over bearing cones (43), then position differential assembly in differential carrier.

6. Place differential bearing caps (45) over studs with alignment marks in line (fig. 3), then tap lightly into position.

7. Insert bearing adjusting rings (8) and turn hand-tight against bearing cups (44).

8. Install nuts on bearing cap studs, tighten nuts to 360-465 foot-pounds torque.

9. Tighten adjusting rings (8) alternately until tight. Revolve differential assembly after each tightening to assure normal bearing contact and to keep bearing cups straight in bores.

DIFFERENTIAL BEARING
PRELOAD ADJUSTMENT

1. Using dial indicator at back face of drive gear (1) as shown in figure 10, loosen bearing adjusting ring (8) on flanged side enough to notice end play on dial indicator.

2. Tighten the same adjusting ring until 0.000" end play is obtained.

3. Tighten both adjusting rings (8) one notch each from 0.000" end play position to impose correct preload on differential side bearings.

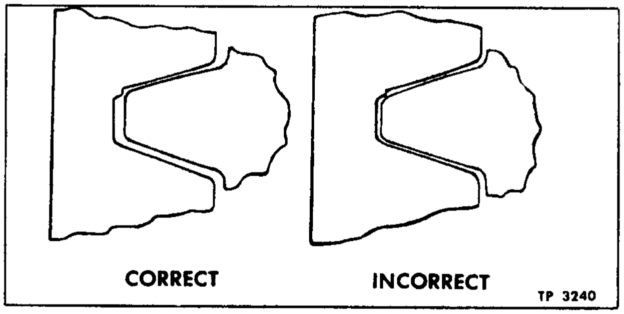


Figure 11—Worn Tooth Cross Section

NOTE: After adjusting bearing preload, proceed with tooth contact and backlash adjustment as directed in following paragraph.

GEAR TOOTH CONTACT ADJUSTMENT

Drive pinion (36) is adjusted for tooth contact by means of shims (17) between pinion cage (30) and differential carrier (16). Drive gear (1) is adjusted by means of adjusting rings (8).

If original gears are reinstalled in assembly, painting gear teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for extensive periods form running contacts due to wear on teeth. Therefore, the original shim pack (17) plus one 0.005" shim should be maintained to check backlash.

In the event that backlash exceeds maximum tolerances, reduce backlash only in the amount that will avoid overlap of worn teeth (fig. 11).

When new gears are to be installed, differential bearings and drive pinion bearings must be in proper adjustment before any attempt is made to adjust backlash. Check backlash with dial indicator as shown in figure 12, and adjust to obtain 0.006"-0.012" lash. Adjust backlash and tooth contact in the following manner:

1. Paint at least ten teeth of bevel gear with a mixture of red lead or prussian blue and engine oil. Rotate gears through a few revolutions in both directions by hand. Refer to gear tooth contact charts (fig. 13) for directions for making proper adjustments.

2. When satisfactory tooth contact and backlash has been obtained, install adjusting ring locks (6) and secure bolts (7) with lock wire.

DIFFERENTIAL CARRIER INSTALLATION

1. Clean flanges of differential carrier (16) and axle housing (10), then position new differential carrier gasket (11) on carrier studs (39).

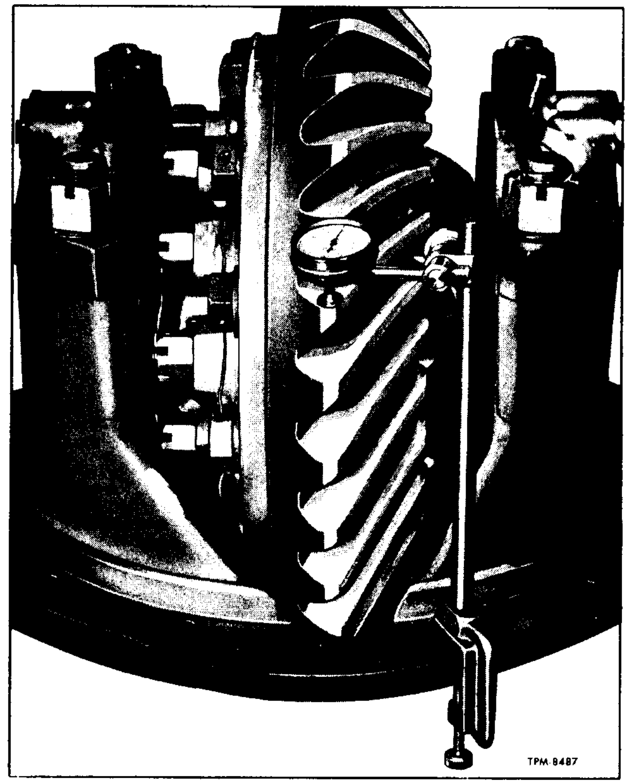


Figure 12—Gear Backlash Check

2. Start carrier into housing using four flat washers (41) and nuts (40) equally spaced, then tighten nuts alternately and evenly to draw carrier squarely into housing.

CAUTION: Driving carrier into axle housing by use of a steel hammer will not only damage carrier stud flange but will also cause oil leaks.

3. Remove nuts and flat washers, then install lock washers and stud nuts. Tighten nuts to 285-365 foot-pounds torque.

4. Install parking brake camshaft, brake shoes and drum as directed in "PARKING BRAKE" (SEC. 4).

5. Install drain plug and tighten firmly. Fill axle housing to proper level with lubricant specified in LUBRICATION (SEC. 13). Install and tighten filler plug.

6. Install axle shafts as previously directed under "Axle Shaft Replacement" in this section.

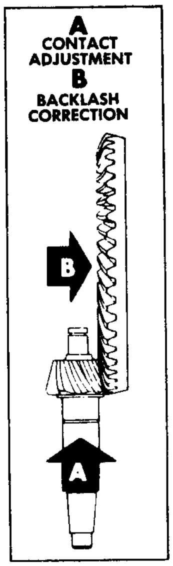
Refer to next page for figure 13.

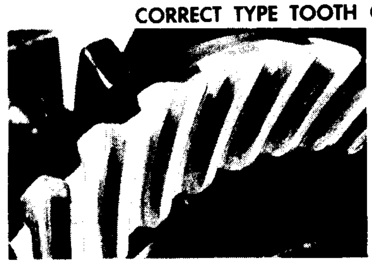
REAR AXLE

PAINTING GEAR TEETH

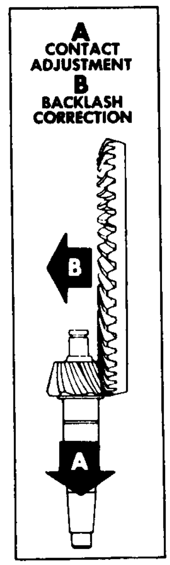
CORRECT TYPE TOOTH CONTACT

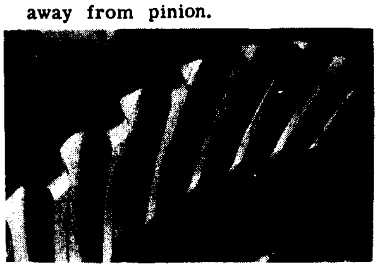
A HIGH NARROW CONTACT is not desirable. If gears are permitted to operate with an adjustment of this kind, noise, galling and rolling over of top edge of teeth will result. To obtain correct contact, move pinion toward bevel gear. This lowers contact area to proper location. This adjustment will decrease the backlash which may be corrected by moving bevel gear away from pinion.



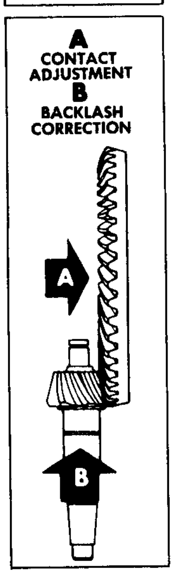


A LOW NARROW CONTACT is not desirable. If gears are permitted to operate with an adjustment of this type, galling, noise and grooving of teeth will result. To obtain correct contact, move pinion away from drive gear. This will raise contact area to proper location. A correct backlash is obtained by moving bevel gear toward pinion.





A SHORT TOE CONTACT is not desirable. If gears are permitted to operate with an adjustment of this type, chipping at tooth edges and excessive wear due to small contact area will result. To obtain correct contact, move drive gear from pinion. This will increase the lengthwise contact and move contact toward heel of tooth. Correct backlash is obtained by moving pinion toward bevel gear.



A SHORT HEEL CONTACT is not desirable. If gears are permitted to operate with an adjustment of this type, chipping, excessive wear and noise will result. To obtain correct contact, move drive gear toward pinion to increase lengthwise contact and move contact toward toe. A correct backlash is obtained by moving pinion away from drive gear.

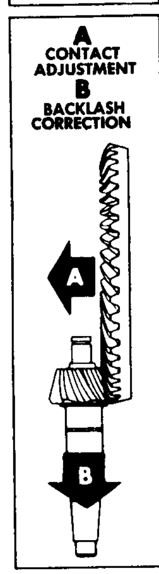


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Figure 13—Tooth Contact Chart (Illustrations Are Typical)

REAR AXLE SPECIFICATIONS

TYPE	Angle Spiral Bevel
DRIVE	Radius Rods
RATIO	
Standard	$4\frac{1}{8}$ to 1
Optional	$4\frac{3}{8}$ to 1
ADJUSTMENTS AND CLEARANCES	
Drive Gear and Pinion Backlash	0.006″-0.012″
Adjustment Method	See Text
Shim Thickness (Carrier to Cage)	0.003″-0.005″-0.010″-0.020″
Pinion Bearings	
Adjustment Method	Selective Spacers
Spacer Thickness	0.187″-0.188″-0.190″-0.192″-0.194″-0.196″-0.198″-0.200″-0.201″-0.215-0.229″
Rotating Torque (In. Lbs.)	5-15
Differential Bearings	
Adjustment Method	Threaded Adjusting Rings
Bearing Pre-Load	See Text
DIFFERENTIAL CASE	
Run-Out (Max.)	0.002″
SPIDER PINION	
Bore Diameter (Grind)	1.252″-1.254″
Clearance—Pinion to Spider	0.004″-0.008″
SPIDER	
Diameter of Arms	1.246″-1.248″
Arms in Same Plane Within	0.0025″
THRUST WASHER THICKNESS	
Side Gear	0.121″-0.125″
Spider Pinion	0.058″-0.062″
AXLE SHAFT	
Type	Full Floating
Drive Flange Run-Out (Max.)	0.005″
Shaft Run-Out at Center (Max.)	1 16″
Diameter at Splined End	2.372″-2.377″
TORQUE SPECIFICATIONS (Ft. Lbs.)	
Propeller Shaft Flange Nut	800-1100
Pinion Cage Stud Nuts	95-100
Carrier to Housing Stud Nuts	285-365
Differential Case Bolt Nuts	185-205
Differential Bearing Cap Stud Nuts	360-465
Bevel Gear Cap Screw	255-280
Adjusting Ring Lock Cap Screw	15-20
Axle Shaft Flange Stud Nut	75-100

Refer to LUBRICATION (SEC. 13) for type of lubricant and draining intervals.

Body

This group is divided into three sections covering "GENERAL BODY MAINTENANCE," "HEATING AND VENTILATION," and "LAVATORY."

General Body Maintenance

GENERAL MAINTENANCE

Unlike the conventional motor vehicles which have separate frame the coach body comprises the main structure of the vehicle. Body construction is basically aluminum, reinforced with steel components. Chassis units such as the power plant, axles and steering system, etc., are attached directly to the body.

The body framing and outer panels are constructed into a box-type unit which absorbs all the road shock, driving and braking stresses. A small amount of twist occurs in body, as complete rigidity of the structure is not desirable. It is, therefore, important that body be regularly inspected for loose rivets and bolts.

Entire vehicle should be regularly inspected for condition of paint and for corrosion damage, with particular attention given to underside. Inspection should be made more frequently in freezing weather due to the corrosive effect of road deicing materials (salt, calcium chloride, etc.) on metal. If inspection discloses any evidences of corrosion, paint failure, or bare metal, corrective measures as outlined under "Painting" (later in this section) should be immediately employed.

If fiberglass parts, such as the headlamp panels, the front belt molding and the stop and tail lamp panel become damaged, they can be repaired as explained later under "Repair of Fiber Glass Parts."

EXTERIOR MAINTENANCE

Body painted surfaces and polished side moldings should be protected by a coating of wax, applied at regular intervals. Periods between applications should be sufficiently short to assure continuous protection of the finish. Any good body wax can be used for both painted and polished surfaces. Wax should be applied immediately after coach has been cleaned.

When necessary to remove previous wax coating, gasoline or similar solvents meeting local fire and health regulations may be employed.

Hard, anodized finish on side moldings is produced by an electrochemical process. Anodic coating is abrasion-resistant and may be cleaned, if necessary, with a mild abrasive cleaner. However, this finish, like other aluminum, is attacked by many acids and most alkalies. Consequently, considerable care should be taken in the selection of chemical cleaners. Do not use an alkaline cleaner.

3

PAINTING

Aluminum corrodes just as iron and steel rusts. Under certain conditions aluminum will corrode more rapidly than steel. Inspect body surfaces regularly for corrosion and paint condition.

REPAINTING ALUMINUM PARTS

1. Thorough cleaning is essential: All corrosion, grease and other foreign matter must be removed. Solvent cleaning, pressure steam cleaning, wire brushing, and hand sanding methods are recommended.

2. Completely remove old paint by use of organic solvents. Do not use alkaline paint remover on aluminum. If old primer is very difficult to remove and there is no evidence of metal corrosion, old primer may be left on, but all loose paint must be removed.

3. Apply a coat of pre-primer (sometimes called wash-primer), preferably by spraying to a uniform and complete coverage coat on all surfaces. This type primer uses a special accelerating agent containing phosphoric acid which produces an excellent bond to metal. AP-10 made by United Chromium, Inc., and XE-5220 made by Bakelite Corporation, or any equivalent material made by a reputable paint manufacturer should be acceptable. These materials must be used within a few hours after addition of accelerator, therefore, directions of manufacturer should be observed carefully. In lieu of a pre-primer, apply warm 5% sodium dichromate or potassium dichromate solution (two ounces dichromate in one quart of water) to cleaned surfaces. Apply by spraying. Allow parts to dry.

4. Use a zinc chromate primer such as DuPont 63-1016 or Arco 214-30089, or any equivalent material made by a reputable manufacturer.

Apply primer, preferably by spraying, in a very thin coat. If zinc chromate primer cannot be obtained, use of a red oxide primer is recommended, but only as an emergency measure.

5. Apply finish coats:

a. For understructure and other parts not requiring color, apply two coats of the following, or equivalent; Reduce five parts of DuPont RC-147 clear Dulux with one part Duco #3637 Thinner. To each gallon add two pounds Albron (aluminum) paste, stirring mixture thoroughly.

b. If synthetic aluminum enamel is not available, any synthetic or other enamel, aluminum lacquer, or other lacquer, in that order, may be used; but only materials made by a reputable manufacturer should be employed. Then apply one heavy coat of asphalt-base sheet metal deadener approximately 1/32" thick, Special spray equipment, including pressure tank, must be used if deadener is applied by spraying.

c. To exposed body parts, apply air-drying surfacer and color coats in accordance with standard practice.

REPAINTING STEEL PARTS

The foregoing procedures may also be applied to steel and iron parts, with following exceptions:

1. Apply a coat of pre-primer (sometimes called wash-primer), preferably by spraying to a uniform and complete coverage coat on all surfaces. This type primer uses a special accelerating agent containing phosphoric acid which produces an excellent bond to metal. AP-10 made by United Chromium, Inc., and XE-5220 made by Bakelite Corporation, or any equivalent material made by a reputable paint manufacturer should be acceptable. These materials must be used within a few hours after addition of accelerator therefore, directions of manufacturer should be observed carefully. Use of phosphoric-base metal conditioner, such as "Metalprep" (Neilson Chemical Co.) or "Deoxidine" (American Chemical Paint Co.) is also recommended in preparing steel for painting. These materials vary in method of application and use, and should be employed only as directed by the manufacturer.

2. Both organic and alkaline paint removers may be used on steel parts. However, if alkaline removers are used, all traces of alkali must be washed off before primer is applied.

3. Oxide-type primer is recommended for use on steel parts, instead of zinc chromate primer.

PAINTING NEW ALUMINUM PARTS

When installing new aluminum parts, or new parts which contact with aluminum parts in assembly, succeeding procedures should be followed:

1. Remove old parts to be replaced.

2. Treat all exposed sides of adjacent parts remaining in body according to previous instructions in steps 1, 2, 3, and 4 under "Repainting Aluminum Parts," if aluminum; if steel, treat as in steps 1, 2, and 3 under "Repainting Steel Parts." Apply finish coat per step 5a. under "Repainting Aluminum Parts" to all surfaces both steel and aluminum.

3. Prime coat all sides of new parts to be installed as outlined in step 4 of "Repainting Aluminum Parts," and step 3 of "Repainting Steel Parts"; then apply finish coat as in step 5a. under "Repainting Aluminum Parts" to all surfaces both steel and aluminum.

4. Use only zinc or cadmium coated bolts, washers, and nuts. Dip all bolts, nuts, washers, and rivets in primer and allow to dry.

5. Install new parts, then apply finish coats as outlined in step 5 of "Repainting Aluminum Parts."

PAINTING NEW STEEL PARTS

The above procedures may be applied to new steel and iron parts except that oxide base primers are recommended in place of zinc chromate type.

REPAIR AND REPLACEMENT OF STEEL OR ALUMINUM PARTS

GENERAL

Body and underframe can be repaired and replaced by competent craftsmen with proper tools and equipment.

In the event of serious collision damage, the Coach Technical Service Department of GMC Truck and Coach Division will furnish data, sketches, and other information upon request. Reply will be expedited by specific description of damage, and particularly if photographs are furnished.

REPLACING BODY PARTS

Whenever repairing or replacing aluminum parts, carefully follow accepted and recommended practices. The Aluminum Company of America will furnish, upon request, booklets titled "Riveting Alcoa Aluminum" and "Welding and Brazing Alcoa Aluminum." The booklets explain detailed procedures necessary in repair and replacement of aluminum parts.

Proper precautions must be observed, particularly with reference to welding, reinforcing, corrosion prevention, and replacement, as follows:

1. Welding of aluminum structural members, or any aluminum parts subject to strain or compression, is not recommended. To maintain proper body strength, replace damaged posts, and other structural members with new parts obtained from the factory.

2. To prevent galvanic corrosion of aluminum, all surfaces of dissimilar metals in contact with aluminum must be properly coated with paint and or plating. This also applies to attaching parts such as bolts, washers, nuts, and rivets. Refer to "Repainting Aluminum Parts" and "Painting New

Aluminum Parts," earlier in this secton.

CAUTION: Avoid mixing steel and aluminum structures or parts when making repairs. Do not substitute steel for aluminum in coach structure. Steel can be used for support fittings for separate units, such as air tanks, control rods, etc. Greater deflection of aluminum causes steel parts to tend to take entire load when used in combination with aluminum parts.

STRAIGHTENING

Use of heat when straightening structural parts of body is not recommended, since heat affects structural characteristics of certain alloys and especially heat-treated parts. All body structural members should be straightened cold; any part bent or buckled sufficiently to show strains or cracks after straightening should be replaced, or properly reinforced.

CUTTING

When cutting a structural member, cut at an angle of 30 degrees. Thus, actual length of cut is twice width of piece being cut, and stress or load is distributed over a longer joint when welded. Cutting can be done by torch, although use of saw is preferred, since cut is cleaner and less material is removed.

REINFORCING

CAUTION: Before reinforcing any part of vehicle, determine cause of failure. Body and frame are integral; therefore, driving stresses and strains are transmitted throughout body. Reinforcing a point of apparent failure without correcting underlying cause of failure, may transfer stress to other parts not engineered for such stress, with resultant development of new failures. Since body is designed to "weave" a rigid reinforcement in any part of body may nullify the design of entire vehicle.

Reinforcements can be made of flat, angle or channel stock, whichever is most suitable for purpose. Use of angle reinforcements is recommended due to difficulty in fitting channel reinforcements. Reinforcements should be sufficiently long to distribute load evenly over a considerable area and thickness should not exceed that of member being reinforced. Reinforcements should be riveted to broken parts.

RIVETING

Cold aluminum rivets should be used in aluminum parts.

Diameter of rivets should be approximately 100% thickness of plates to be riveted, although rivet diameter is also dependent upon spacing and number used.

Replacement of body parts will necessitate removal of rivets in many cases. Rivets can be removed readily by cutting off rivet head with a sharp chisel, marking center of rivet with a center punch, then drilling out rivet with a drill slightly smaller than body of rivet. Rivet can also be driven out with punch, instead of being drilled out, depending upon type and size of material riveted. If rivet is large, first cut a groove across center of rivet head with a cape chisel before cutting off head with a flat chisel.

WELDING

Refer to Step 1 under "Replacing Body Parts," regarding welding of structural parts.

Inert arc welding is recommended as heat of weld is localized and burning of material minimized with this method. When welding a cut member, fill or weld cut completely. Welding rods should be of substantially same material as parts to be welded.

SEALING

When replacing front, side, rear panels, and particularly roof panels, special attention should be given to sealing of joints with sealing and caulking compounds.

REPAIR OF FIBERGLASS PARTS

Repair procedure of fiberglass parts are simple and the paint refinishing procedure is the same as recommended previously for metal parts.

In general, all repairs to fiberglass parts consist of filling the damaged area with fiberglass cloth and resin or chopped fiberglass and resin. The repair is allowed to harden and then the finishing operations are performed. Use of the various materials is determined by the type of repair to be made. Such repairs as large holes, torn sections, and separated joints require the adhesive qualities of the resin and the reinforcing qualities of the fiberglass sheets. Small dents, scratches, or pits can be repaired using resin and chopped fiberglass (roving) and filler mixed into a paste. Instructions for use of either mix are explained later under respective headings.

For best results the ambient temperature should be approximately 70° to 75°F., when making repairs.

Some people experience a skin reaction to resins when making repairs. When, and if, this happens, wipe off the skin with denatured alcohol or a good thinner. There are several protective hand creams on the market which can be applied to protect the hands. Use of this cream is recommended.

If any quantity of disc grinding or sanding is to be done in an enclosed area, a respirator should be used. Goggles should also be worn whenever grinding or sanding.

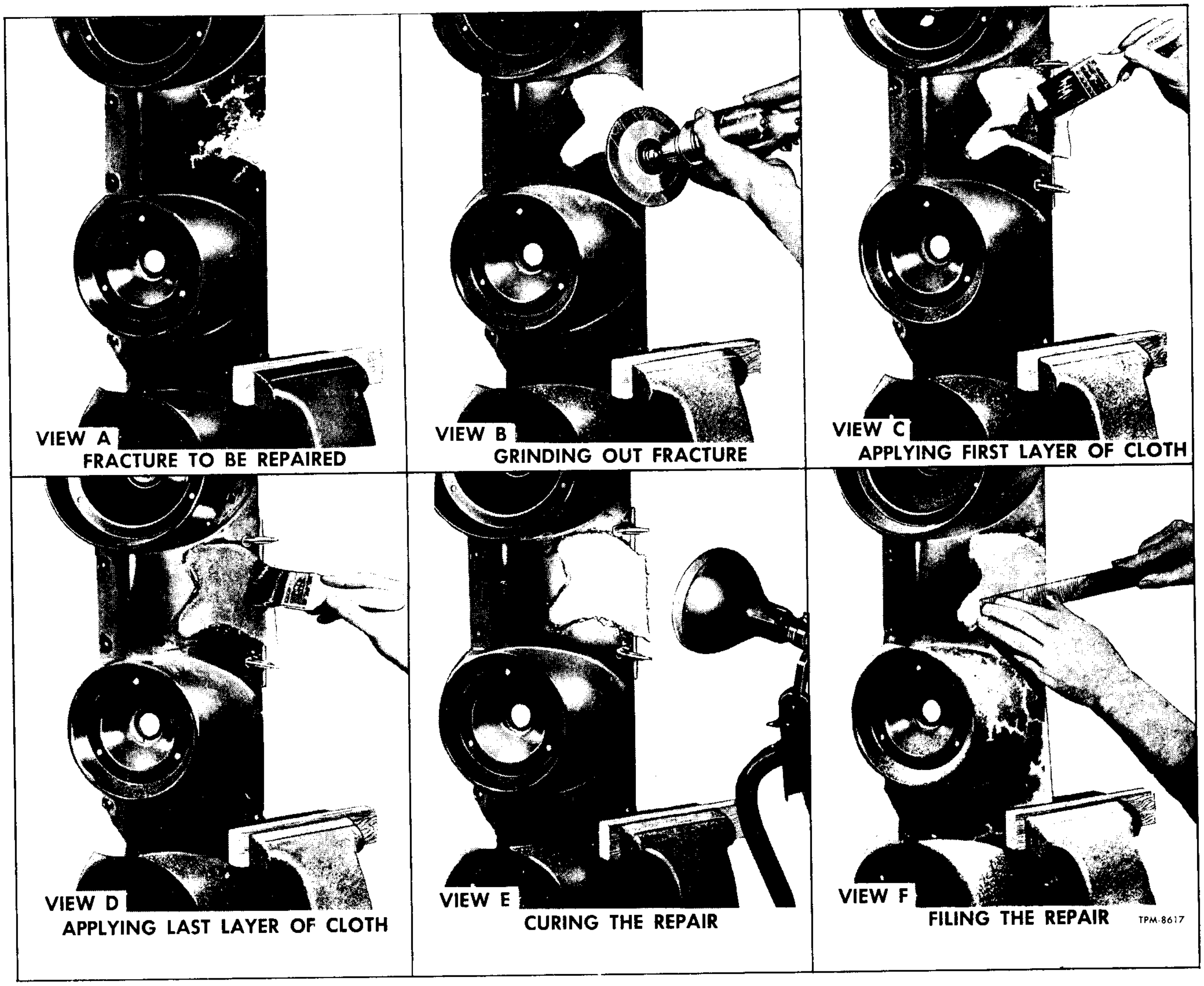


Figure 1—Fiber Glass Repair Views

Extreme care must be used if the sander is electrically driven as dust of some resins is combustible when subject to sparks or open flame. The proper tool for sanding resin is a low speed, air driven disc sander with a water attachment or a dry sander having a vacuum bag attachment. Either type sander will serve to eliminate flying glass and resin dust.

The following additional tools and materials will assist in making repairs: Hacksaw blade, assorted files, emery paper or cloth (No. 150 grit or finer), scissors or tin snips, wax paper or cellophane sheets, wallpaper type seam roller, paint brush, putty knife, lacquer thinner, and one or more heat lamps.

Use the right fiberglass materials for the job. When making a repair, use GM Resin Repair Kit - No. 2233617 or equivalent. GM Resin Repair Kit includes fiberglass sheets, roving, and filler material, also resin, hardener, mixing cup, spoons and an instruction sheet. The fiberglass roving and filler mixed in with the resin and hardener will form a paste which can be used for making small repairs.

The following is the recommended procedure for making repairs using GM Resin Repair Kit.

REPAIR PROCEDURE USING FIBERGLASS CLOTH

1. Examine the repair area for hidden damage. Apply pressure by hand around the area. View A, figure 1 shows a fractured fender.

2. Use paint remover and remove finish from around damage area. NOTE: Do not allow remover fluid to run onto area not requiring repair. Inspect area again for signs of other damage.

3. Grind or file the damaged area to form a "V" at the broken or cracked portion (View B, fig. 1). Side of "V" should have a shallow pitch for

maximum bonding surface. NOTE: Roughening the surface improves adhesion of resin.

4. If back side of damage is accessible, use a button-type repair whereby the rear side of break or crack is also repaired. Clean back side to permit use of laminate (resin-saturated glass cloth) on both sides of damaged area.

5. If paneling is warped from original shape use "C" clamps and improvised clamp plates to align surfaces (View C, fig. 1).

6. Preheat area to be repaired using one or two heat lamps positioned 12 to 15 inches from repair.

CAUTION: 250°F. to 275°F., is the high limit for this material and to go higher is to risk material distortion or crystalizing.

7. Using scissors or tin snips, cut fiberglass cloth to size one to three inches larger than area of repair. Make certain a minimum of five layers is cut for the average repair.

8. Mix desired quantity of resin and hardener in proportions of four parts resin to one part hardener. The amount mixed will vary depending on the size of repair. Generally, a mix of four tablespoons of resin and one tablespoon of hardener will be sufficient for repair of a six inch damage. Measure the resin and hardener into any suitable clean container. Do not use waxed cups for mixing and do not allow resin to enter hardener can or vice versa. Mixture which is too thin can be thickened to desired consistency by adding powdered filler. Two tablespoons of filler to one-half pint of mix will usually supply the correct consistency.

9. Saturate layers of fiberglass with mixture, then place laminates over damaged area (View C, and D, fig. 1). Smooth out wrinkles and make sure general contour of area is maintained. Wrinkles can be rolled out using a roller.

IMPORTANT: Once the resin and hardener have been mixed, the pot-life (working time) of the mix will be approximately 15 minutes. Any accidental contamination to the skin, clothing, tools, etc., must be removed during this period. Use lacquer thinner to remove resin.

10. Apply heat to applied resin material. Again place lamps 12 to 15 inches from repair area (View E, fig. 1). Allow 15 to 20 minutes for repair to cure.

11. After the repair is cured, grind, file or sand to contour (View F, fig. 1). Files other than body files may be more suitable. Feather edge and finish sand.

12. After making repair, small pits or irregularities may appear in finished surfaces. Imperfections should be repaired using a liberal amount of roving or filler mixed with resin to form a paste. See "Procedure Using Fiberglass Paste" explained later.

REPAIR PROCEDURE USING FIBERGLASS PASTE

NOTE: Fiberglass paste is used for repairing small dents, scratches and pits. Paste is made by mixing resin, hardener, and fiberglass roving or filler to the consistency of putty.

1. Perform Steps 1 and 2 explained previously under "Repair Procedure Using Fiberglass Cloth."

2. Preheat the area to be repaired using heat lamps.

3. Mix desired quantity of resin and hardener in proportions of four parts resin to one part hardener. The amount mixed will vary depending on the area of repair. Generally, a mix of two tablsspoons of resin and one-half tablespoon of hardener will be sufficient for repairing a three-inch damage.

4. Add powdered fiberglass roving into the mix to thicken it into a putty state. NOTE: If repair is to be made on a vertical surface, adding of powdered filler material to mixture will reduce the tendency of hot resin to flow or run.

5. Apply the material using a putty knife or similar object. Work the material into the repair and build the material up to the desired contour. For deep filling and on vertical surfaces several layers of material may be used about 1/2 inch thick. NOTE: A hack-saw blade held flat to adjacent contour and then pulled, using sawing action across repair when the resin is in the jell stage, will remove access resin from repair.

6. Finish the repair by performing Steps 10 and 11 explained previously under "Repair Procedure Using Fiberglass Cloth."

EXTERIOR COMPARTMENT DOORS

All exterior compartment doors are rubber hinged at top except engine compartment radiator grille, transmission, and tool compartment doors.

Rubber-hinged compartment doors are of the lift-type. Doors lift outward and up, and are supported in open position by either a telescopic support prop or a straight support rod.

In order to lower compartment doors equipped with telescopic type support prop, it is first necessary to raise door slightly to remove retaining pin on support prop before lowering door.

REPLACEMENT OF RUBBER HINGED DOORS

<u>Removal (Fig. 2)</u>

1. Open door to full open position; then remove screws which secure door hinge channel to hinge.

2. Lower door to a position until door is at an approximate 90 degree angle to side of coach. With the aid of an assistant, slide door from hinge.

<u>Installation (Fig. 2)</u>

1. Apply glycerin, talcum powder or a soap solution to hinge to facilitate door installation.

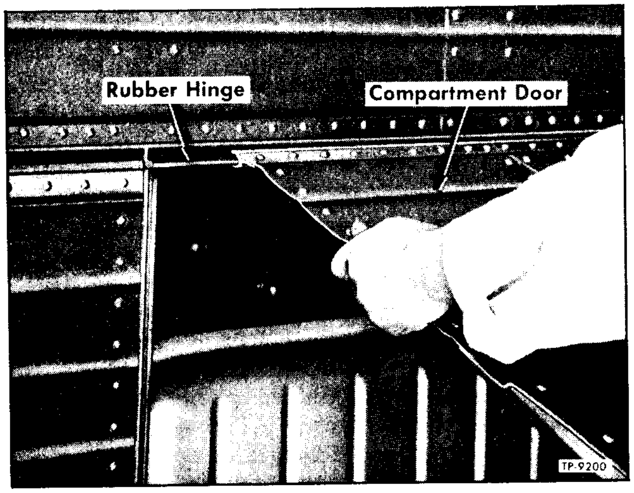


Figure 2—Replacement of Rubber Hinged Compartment Door

IMPORTANT: Do not use oil or grease on hinge.

2. With aid of an assistant at one end of door, align door hinge channel with hinge and slide door onto hinge. Secure door to hinge with screws.

BAGGAGE, HEATING AND AIR CONDITIONING, AND ELECTRICAL COMPARTMENT DOORS

Baggage, heating and air conditioning, and electrical compartment doors, incorporate flush type latch locks as shown in figure 3. Lock operating latch is flush mounted at center rub rail portion of each door. Insert fingers under operating latch; then pull outward and up to unlatch door. To close door, hold door in closed position with operating latch in open or outward position; then release and push down on latch to secure door.

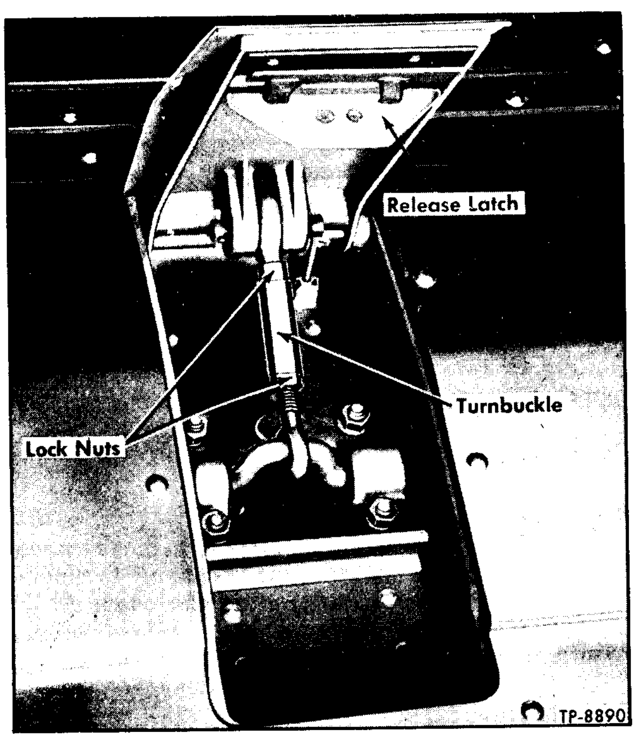


Figure 3—Compartment Door Release Latch

CAUTION: Do not drop door to closed position as damage to door or body may result.

This particular type latch can be adjusted to regulate door-to-body seal tightness. Make adjustment if necessary in the following manner:

1. Loosen two lock nuts (fig. 4) securing turnbuckle on release latch control link.

2. Turn link turnbuckle to obtain desired adjustment of door-to-body seal tightness, then retighten turnbuckle lock nuts.

ENGINE COMPARTMENT DOOR

Engine compartment door, which is hinged at top is opened by pulling lock release handle located inside of door, to the left. Release handle is accessible through opening at lower right corner of door. Door is retained in closed position by two locking rods which engage catches on engine rear hanger tubes. Catches can be repositioned on tubes permitting adjustment of door-to-body fit. Door is held in open position with one telescopic support prop having a hold-open retaining pin. In order to lower door it is first necessary to raise door slightly to allow removal of retaining pin from support prop.

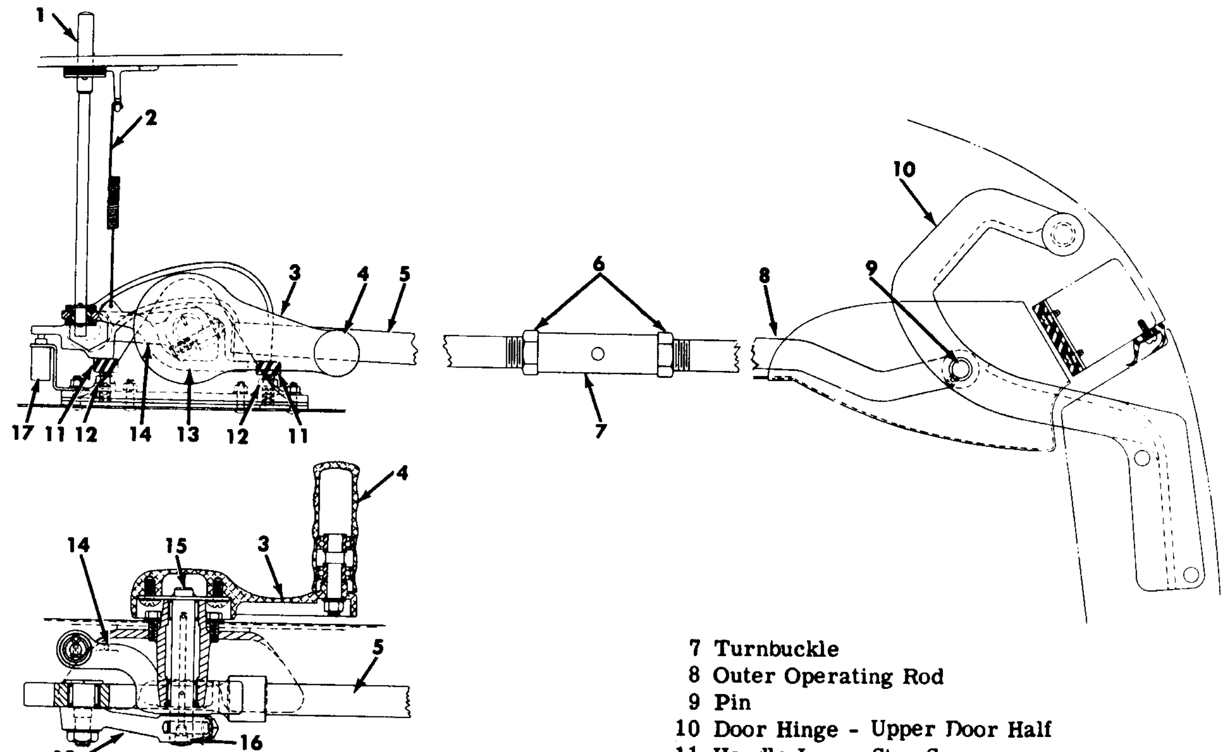
CAUTION: Do not drop door to closed position as damage to locking rods or catches may result.

TOOL COMPARTMENT DOOR

Tool compartment door located at left front corner of coach is hinge mounted at front and swings outward. To open door, pull latch handle, which extends below left bumperette, rearward: then swing door open. Door is retained in closed position by two locking rods which engage body catches at top and bottom of door. Body catches can be repositioned to permit adjustment of door-to-body tightness by loosening catch attaching cap screws; adjusting door-to-body tightness; then retightening cap screws.

TRANSMISSION COMPARTMENT DOOR

Transmission compartment door located at right rear corner of coach is hinged mounted at front and swings outward. Door is equipped with latch at lower rear edge and is retained in closed position by locking rod which engages body catch at top and bottom of door. Body catch and door stop bracket can be repositioned to permit adjustment of door-to-body fit by loosening attaching cap screws, adjusting door, and then retightening cap screws.



1 Door Lock Outside Release Rod
2 Release Rod Return Spring
3 Door Operating Handle
4 Operating Handle Knob
5 Inner Operating Rod
6 Jam Nut
7 Turnbuckle
8 Outer Operating Rod
9 Pin
10 Door Hinge - Upper Door Half
11 Handle Lever Stop Screw
12 Jam Nut
13 Control Handle Lever
14 Outside Lock Release Rod Lever
15 Operating Handle Shaft
16 Lubrication Plug
17 Stepwell Light Switch

TPM-1662

Figure 4—Entrance Door Control Linkage

BATTERY AND A/C COMPRESSOR COMPARTMENT DOORS

Battery compartment door is retained in closed position with two spring-loaded pull-type latch handles located under door. A/C compressor compartment door is retained with only one latch. To open, pull latch handles outward to release door. To retain door in closed position, pull both latch handles outward, press in on bottom of door and engage handles in door catches.

AIR CONDITIONING CONDENSER DOOR

Air conditioning radiator door is retained in closed position with two spring-loaded latch handles located under door. To open door, push down on latch handles which force out latch springs engaging door catches; then push down on latch springs and pull out on door.

To close door, hold door in closed position and lift up on latch springs engaging door catches; then pull down and outward on latch handles.

Door-to-body tightness can be adjusted by repositioning each latch assembly. Screw holes in latch are elongated to permit adjustment.

RADIATOR GRILLE DOOR

Radiator grille door is hinged at top and secured closed at bottom by a single spring-load catch assembly. To open, push down on latch to release the catch, then raise door and prop with support rod attached to door. When closing door, hold door closed, then raise catch handle to engage latch of door.

SPARE TIRE COMPARTMENT DOOR

Spare tire compartment door at front center of coach in back of front bumper also serves as a mounting for the front bumper. Door is hinged at bottom and attached to body framing at top of door with two special lug bolts. To open door, insert wheel lug wrench through each hole in bumper bar and remove lug bolts; then lower bumper and door.

To close door, raise bumper and door assembly to closed position. Insert two attaching lug bolts and tighten firmly.

EMERGENCY DOOR (When Used)

Emergency door incorporates an inside bar-type safety lock. Switch, mounted on door latch pillar and operated by the door lock bar, lights telltale in instrument panel and sounds alarm buzzer to indicate door is not closed and locked. Door should be inspected regularly to make sure of proper operation of door locking mechanism, telltale and buzzer. Refer to WIRING AND MISCELLANEOUS ELECTRICAL (SEC. 7) for information on alarm buzzer and to wiring diagram at rear of manual for checking of electrical circuits.

Door can be adjusted for tightness to body when closed, by repositioning lock bar on serrated lock shaft. Remove screw retaining lock bar flat washer to lock shaft. Reposition lock bar on shaft and check operation. Reinstall flat washer and retaining screw.

ENTRANCE DOOR AND CONTROLS

Entrance door is sedan type, hinged at front, and opens outward. Door is hand-operated type, controlled by door operating mechanism connected between dash and door. Mechanism is so designed that door is locked firmly in either fully open, or fully closed position. Door, however, can be opened from outside vehicle by pushing in on door release rod knob (1, fig. 4) located in front panel below windshield.

ADJUSTMENT

NOTE: Key numbers in text refer to figure 4.

Mechanism is adjusted by loosening two jam nuts (6), which lock turnbuckle (7) connecting door operating rods (5 and 8); then turning turnbuckle to shorten or lengthen rods. Turnbuckle is accessible under dash after entering safety compartment at right side of dash. Tighten turnbuckle jam nuts (6) after desired adjustment of rods is obtained.

Two stop screws (11), which are adjustable, are located on each side of control handle lever (13) under dash panel. Adjustment of stop screws regulate the over-center position of door operating rod control handle lever (13). Properly adjusted mechanism will swing over-center and lock door firmly in both fully open or closed position. In either position, it should not be possible to move door unless operating handle (3) is first moved out of locking position. After adjusting stop screws (11); tighten stop screw jam nuts (12).

SASH AND GLASS

RUBBER INSERT-RETAINED GLASS

A special insert-type rubber retainer seal is used to install glass in standard windshield, destination sign and rear windows. Windshield and rear window glass sections are retained in body openings with bonded seal retainer assemblies which eliminate cutting of retainer to install glass. Although possible to install retainer and seal insert without use of special tool, seal and insert installer tool (J-2189) (fig. 6) is recommended to facilitate installation.

CAUTION: Wear gloves when handling glass.

GLASS REMOVAL

1. Raise one end of insert out of groove in retainer seal with pointed tool; then pull insert from seal by hand.
2. Station an assistant outside vehicle to prevent glass falling; then push glass outward from inside coach.
3. Remove rubber retainer seal or seal assembly from panel by hand.

GLASS INSTALLATION

1. Straighten panel flange around opening to assure a good fit in retainer seal groove.
2. Position retainer seal in panel cut-out, making sure seal is pushed into place in corners. When installing glass in destination sign, make sure ends of seal come together at side of opening near top. Cut off retainer seal ends allowing sufficient overlap to secure a tight joint, then carefully butt seal into position.
3. Apply parafin to glass groove in retainer seal to facilitate glass installation.
4. Position glass to seal, then insert end of retainer seal installer tool (J-2189) in seal groove. Move tool along edge of glass forcing outer lip of seal over glass.
5. Thread end of rubber insert through handle and eye of seal installer tool (fig. 6). At point opposite joint in retainer seal, push tool eye and end of insert into seal groove. Feed into groove in retainer seal using a "hitching" motion to prevent elongation of insert.
6. Cut off insert, allowing sufficient overlap, and butt ends tightly into groove.

WINDSHIELD GLASS (GREYHOUND COACHES)

Windshield glass sections as used on Greyhound coaches are rubber-seal retained within an aluminum frame assembly which is also rubber-seal retained within the coach windshield opening.

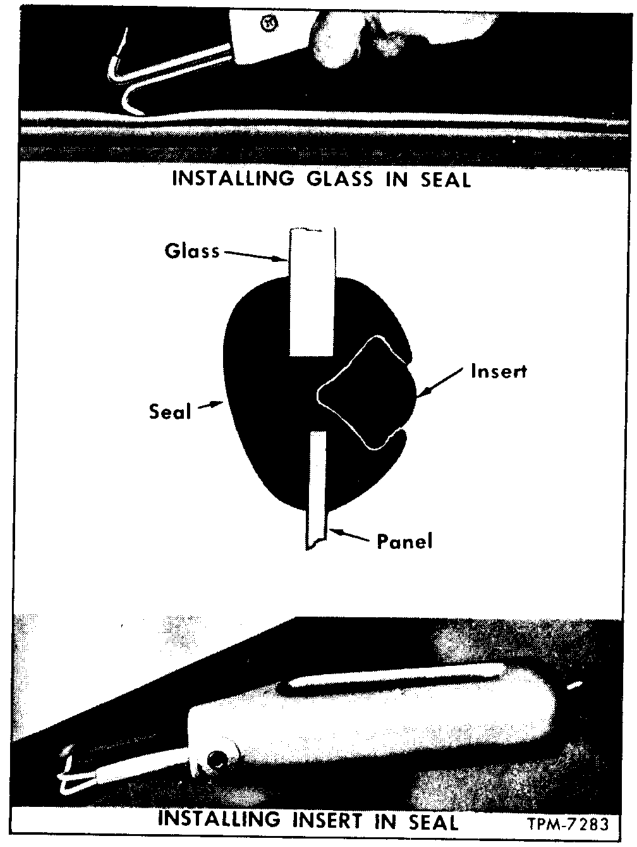


Figure 5—Insert-Retained Glass

Figure 5 shows several views of windshield glass installation. Use of special tools are recommended when installing components of windshield.

CAUTION: Wear gloves to protect hands when handling glass.

GLASS, CHANNEL, AND FRAME REMOVAL

1. Raise one end of each outer glazing strip with pointed tool, then pull strip by hand from around glass section.
2. Station an assistant outside vehicle to prevent glass falling; then force glass outward from opening.
3. If necessary, glass inner glazing strip can be pulled from channel of frame assembly.
4. Frame assembly can be removed from opening after pulling out the inner retaining strip around perimeter of frame assembly. Carefully have assistant remove frame from front of coach.

NOTE: If necessary, weatherstrip can be pulled from frame outer channel.

FRAME AND GLASS INSTALLATION

NOTE: Refer to figure 6 which shows installation views.

1. If frame assembly was removed from opening, place frame with installed outer weatherstrip into windshield opening.
2. Using C-clamps as shown, compress frame assembly against opening flange. CAUTION: Do not distort frame by over-tightening.
3. Apply soap solution to inner retaining strips, then force strips into frame inner channel using lever-type compression tool shown.
4. Install inner glazing strip around each glass opening. Make sure strip is installed uniformly, leaving no humps in rubber.
5. Coat the outer glazing strips in soap solution, then with glass located into glass opening, install outer glazing strips. Use blade-type tool to force strip into position between glass and frame outer flange. Press strip evenly into channel completely around perimeter of glass. Test for leaks around glass.

LONG SIDE WINDOW SASH

Long side windows consist of two sections of sliding sash and glass enclosed in a one-piece aluminum frame (fig. 7). Window can be opened by sliding front section rearward and rear section forward. Each section is retained in closed position by a latch-type lock.

EMERGENCY ESCAPE

Long side windows are hinged at top to provide passenger escape under emergency conditions. Window is retained in closed position at bottom by two springs and spring keepers. Springs are attached to sash and keepers are attached to sill opening. Pushing outward on lower portion of window will cause springs to compress over keepers and permit window to swing outward.

SIDE WINDOW REMOVAL (Fig. 7)

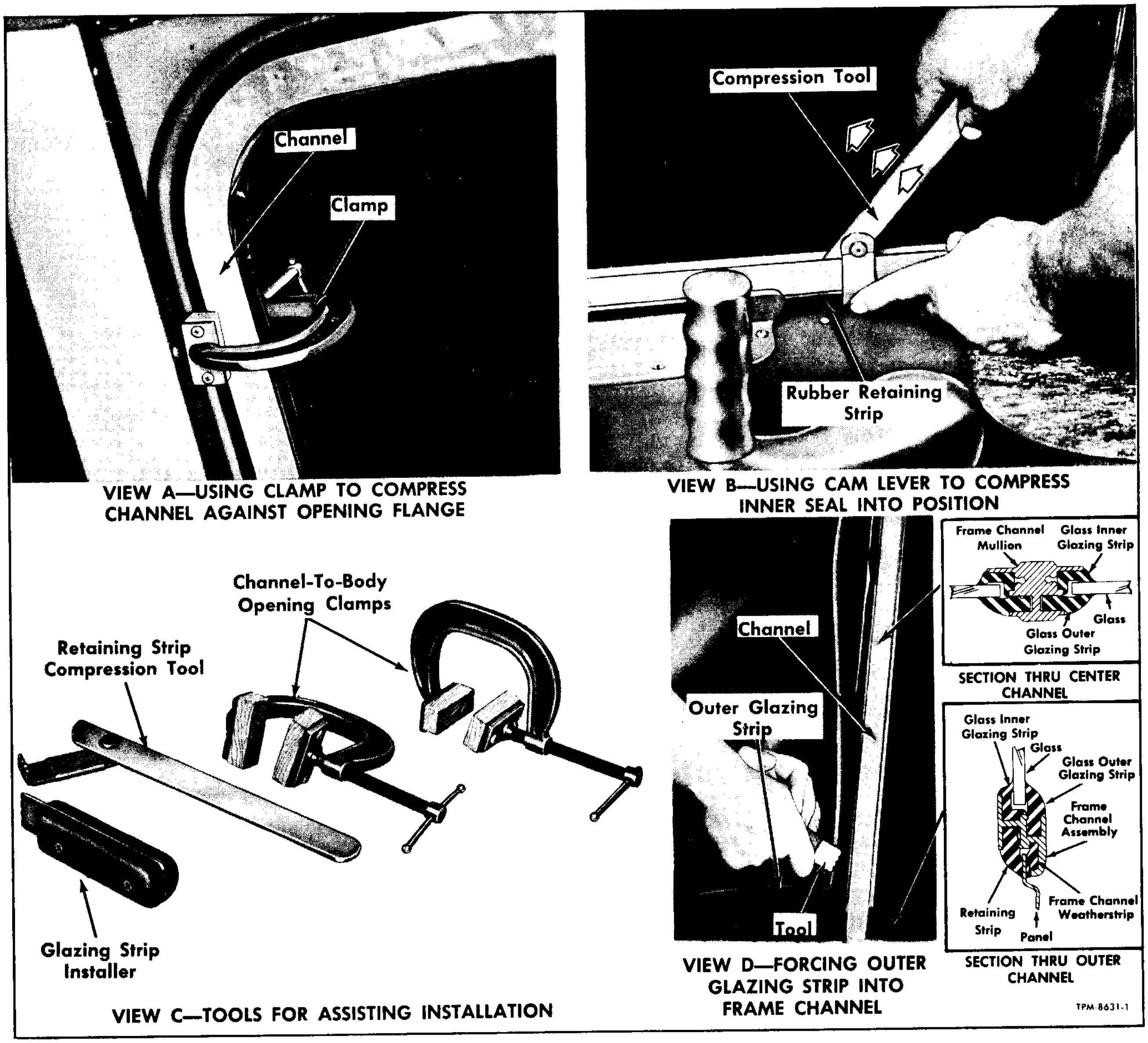
Side window is readily removed after first opening window to emergency release position. With the aid of an assistant to hold window, remove screw from end of each hinge pin, then remove pins from hinges. Push out at top of sash, then lower window assembly from opening.

SIDE WINDOW INSTALLATION

1. Before installing window, inspect window outer seal and rubber support blocks. Replace if necessary. Also check condition of push out springs and keepers at bottom of sash. Figure 8 shows springs and keepers installed. If necessary, either can be readily replaced.

IMPORTANT: When installing new springs to bottom of sash, make sure heads of new installed rivets are low enough to prevent interference with sliding section frame.

Position of keepers on sill below sash are adjustable in or out to provide proper tightness of sash in opening by means of two slotted attaching



VIEW A—USING CLAMP TO COMPRESS CHANNEL AGAINST OPENING FLANGE

VIEW B—USING CAM LEVER TO COMPRESS INNER SEAL INTO POSITION

VIEW C—TOOLS FOR ASSISTING INSTALLATION

VIEW D—FORCING OUTER GLAZING STRIP INTO FRAME CHANNEL

Figure 6—Windshield Glass Installation (Greyhound)

screw holes. Locate keepers to position sash assembly snug in opening.

2. With support blocks located at bottom and ends of window frame, position window assembly to opening in coach. Insert hinge pins, then secure each with a screw.

3. Referring to figure 9, slide front and rear sections to center, then raise bottom of sash at point "A" and then let weight of window assembly rest on body sill. Inside of coach, at points "B," pull inward evenly to raise bottom of window up over spring keepers to installed position.

SLIDING SASH AND GLASS REMOVAL

CAUTION: Wear gloves when handling glass.

1. Remove side window as previously directed under "Side Window Removal."

2. Remove two screws which attach one end of tie bar to window frame (View "A," fig. 10). Purpose of tie bar is to prevent window frame from spreading in the center when window is being carried or when in emergency escape position.

3. Referring to View B, fig. 10, spread window frame in the center only enough to permit removing sash and glass sections from frame channels.

4. To disassemble sash and glass sections remove screw (View A, fig. 11) at upper and lower end of section vertical-slanting end rail. Remove end rail, then carefully remove broken glass and glazing rubber from sash.

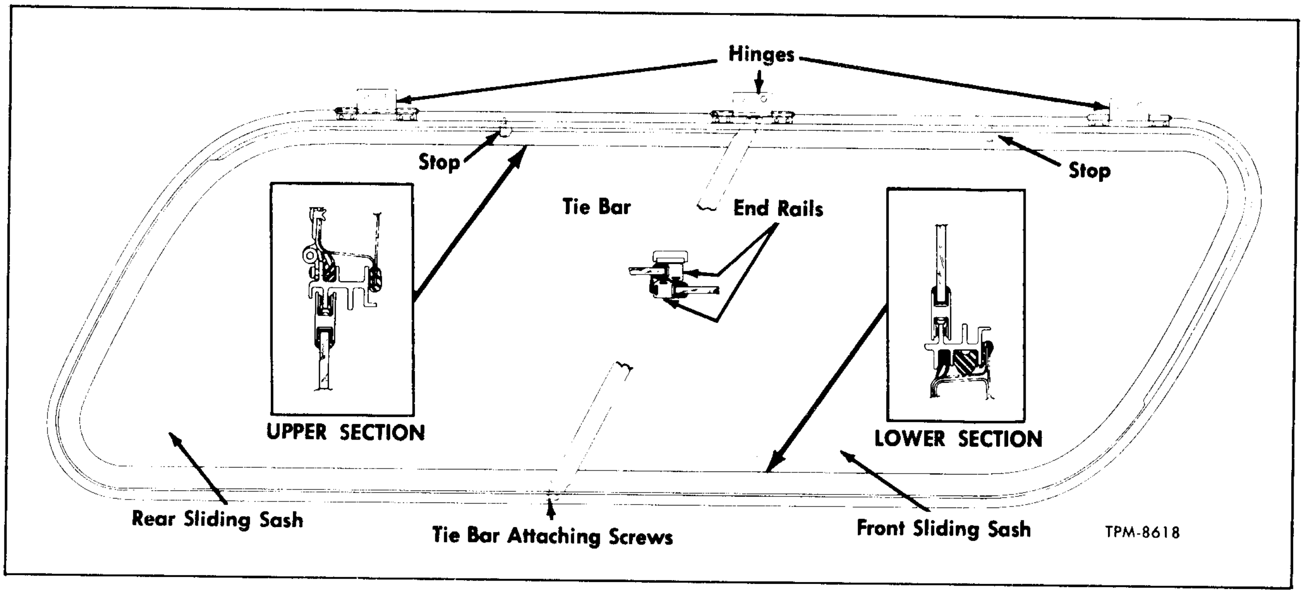


Figure 7—Long Side Sash Assembly

SLIDING SASH AND GLASS INSTALLATION

1. Clean glass sash channels thoroughly.
2. Position new glazing rubber on glass; then using parafin or glycerine on glazing rubber to facilitate glass installation, install glass with rubber in sash.
3. Using a strong cord as a tourniquet to press sides of frame into position as shown in View B, figure 11, install vertical-slanting end rail to sash with attaching screws.
4. Spread window frame apart at center only sufficiently to allow installing sash in frame channels (View B, fig. 10).
5. Install tie bar to window frame with screws (View A, fig. 10).

SLIDING SASH POSITION LOCK

Two lock assemblies are located at bottom of window assembly for retaining sliding sections in closed or open positions.

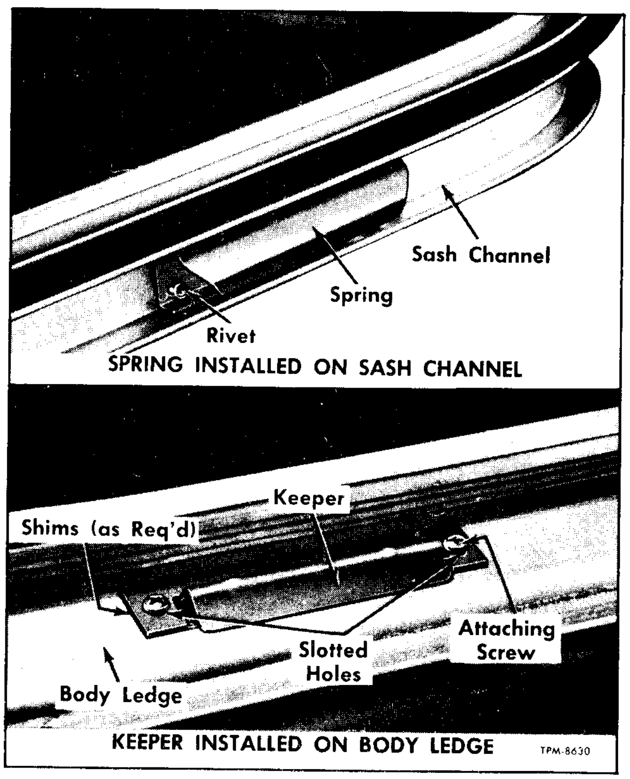


Figure 8—Long Side Sash Push-out Spring and Keeper Installed

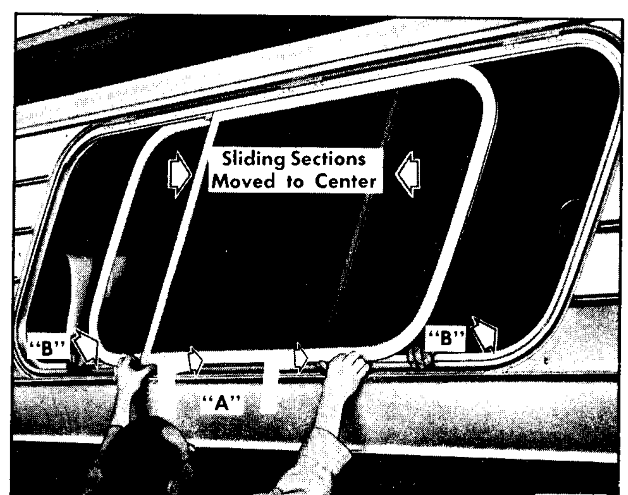


Figure 9—Installing Long Side Window

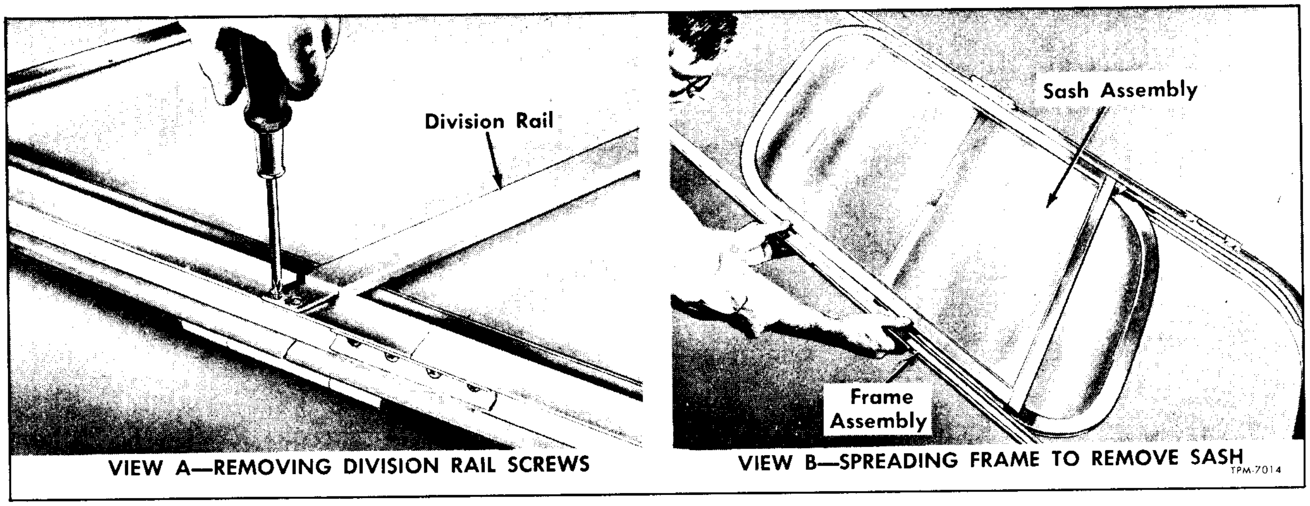


Figure 10—Replacing Long Sash Sliding Sections

Pushing inward on release button should free lock plunger from notch in sash rail. If release mechanism binds or fails to operate properly, remove lock assembly from sash frame.

Using a pointed or flat bladed tool, pry backing plate from rear side of lock body. If operation of release button does not indicate point of trouble, pull small pin which retains all moving mechanism in position. Remove components from lock body. Check for broken or distorted springs and also for rough spots on all sliding surfaces.

Sparingly apply Lubriplate to all sliding surfaces (fig. 12); then operate to check action. If operation is satisfactory reinstall backing plate, then install lock assembly to sash.

Check operation of all sash locks at regular periodic inspections. Replace if necessary.

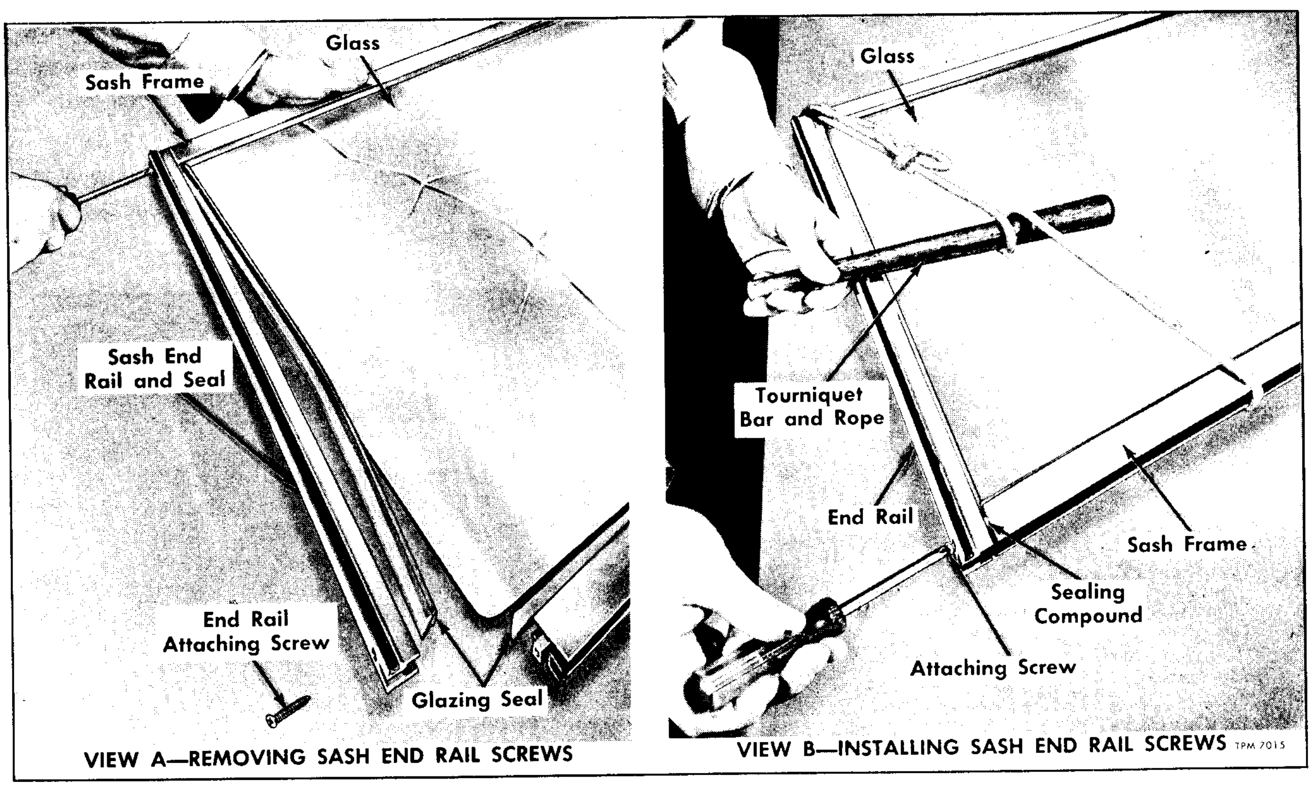


Figure 11—Replacing Sliding Section Glass (Typical)

STATIONARY WINDOW SASH

Number one sash at rear of entrance door and at rear of driver's window are of stationary type.

NOTE: It is not necessary to remove glass frame from vehicle in order to replace glass.

1. To remove cracked or broken glass from frame, pry small rubber insert from rubber glass channel in one place sufficiently to grasp with hand. Pull end of insert from around channel. Glass can now be removed from rubber channel by pressing outward on glass.

2. To install new glass, position glass into channel groove using tool J-2189 in manner shown in figure 5. If necessary, parafin or soap solution can be applied to rubber to facilitate installation. Using tool J-2189 install rubber insert into rubber channel groove to lock sash firmly in position. Cut insert ends, allowing sufficient overlap to secure a tight joint; then butt ends of seal into position.

3. Glass with frame as a unit, can be removed from window opening after removing attaching eight screws. Screws are accessible under rubber seal inside of coach. With the aid of an assistant outside coach to hold sash and frame, push outward on sash assembly. Window glass channels can be separated if desired after removing two screws which attach vertical channel to frame channel.

4. If glass frame was removed from coach, position frame in opening, then from inside of coach, install screws attaching frame to body.

DRIVER'S WINDOW AND ENTRANCE DOOR WINDOW

Driver's window and entrance door window are practically the same in design except that rear section of driver's window is hinged and equipped with a small slide section for operator's used. Entrance door window rear section is not hinged and is of the stationary type.

Curved forward section of each window is hinged and will swing outward. To open front section of either window or rear section of driver's window, pull window regulator handle inward and toward window hinge. Push out on regulator handle to lock window in open position.

WINDOW REMOVAL

Driver's window assembly can be removed from coach after removing regulator handle bracket and hinge bracket screws attaching window to coach body. Entrance door window assembly can be removed from door after removing regulator bracket screws and screws which attach window rear section to door frame.

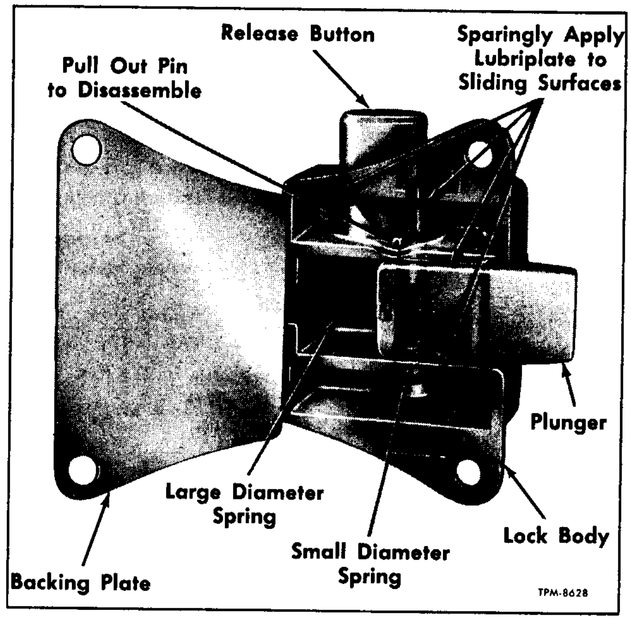


Figure 12—Long Sash Lock Mechanism

GLASS REPLACEMENT

Glass can be replaced in window sections after removing screws which attach window inner retainer molding to window outer frame. Glass can be removed from small sections of driver's window after removing screws from ends of section frame. Remove all old glazing rubber from window framing.

Position new glazing rubber around glass and install glass with glazing rubber in window frame. Position window inner retainer molding in place; then install inner retainer molding to window outer frame with screws.

WINDOW INSTALLATION

Before installing windows in openings, inspect seals and replace if necessary. Snugness of window hinged sections to body seal can be adjusted by loosening regulator body bracket screws, shifting bracket; then retightening bracket screws.

MISCELLANEOUS EQUIPMENT

WINDSHIELD WIPERS

Two air-operated windshield wipers are mounted in front panels, below windshield. Air pressure for wiper operation is supplied by auxiliary air system, fed in turn from coach main air system. A pressure regulating valve, interposed in air lines (fig. 13), prevents depletion of main air system when pressure in main air system falls below approximately 65 psi.

Windshield wiper motors are individually controlled by valves, mounted on dash panel below

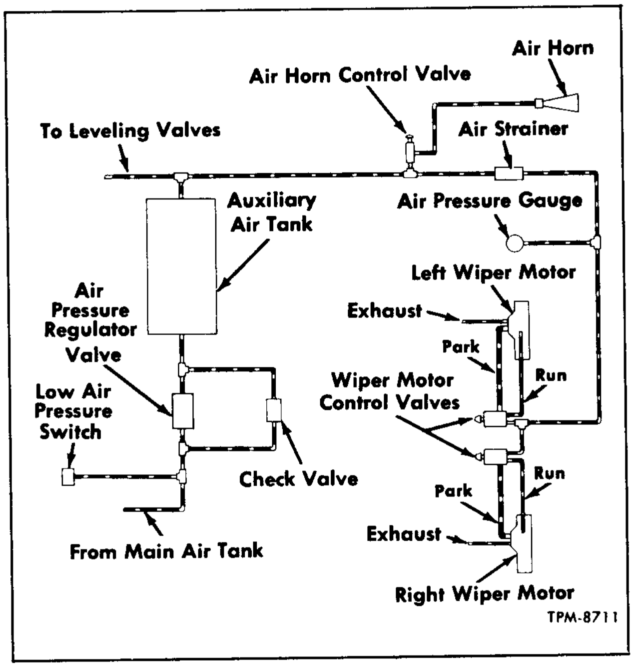


Figure 13—Schematic Air Line Diagram

right side of instrument panel. Valve can be partially disassembled for cleaning as explained later.

Refer to BRAKES (SEC. 4) for maintenance and repair information on auxiliary system air pressure regulator valve, air lines, and connec-

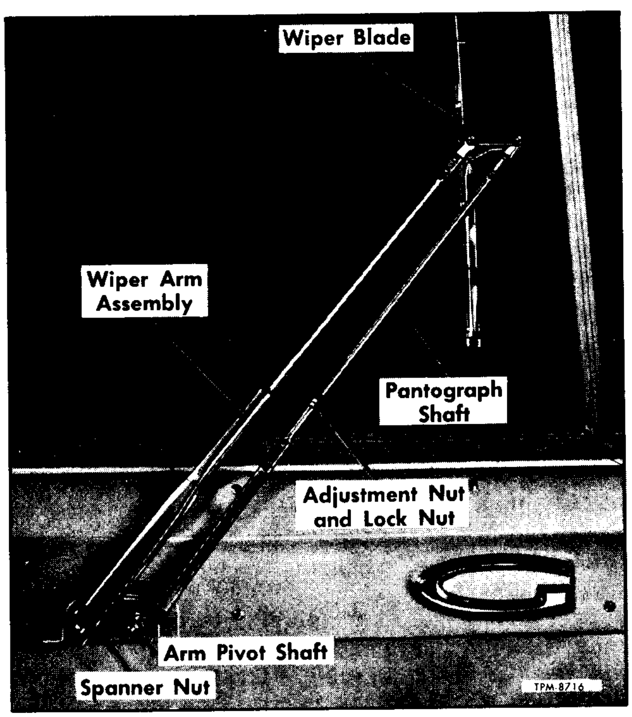


Figure 14—Windshield Wiper Arm and Blade

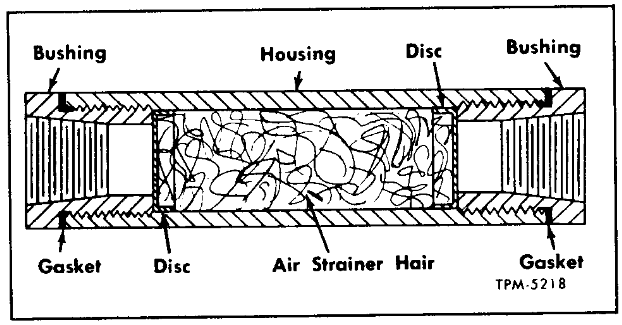


Figure 15—Windshield Wiper Air Strainer

tions. Figure 13 illustrates typical systematic diagram of windshield wipers and controls. NOTE: Before disconnecting any wiper lines or replacing any wiper unit, deplete air pressure from auxiliary air system.

WIPER BLADE ANGLE ADJUSTMENT (Fig. 14)

Pantograph shaft length is adjustable to allow setting wiper blade angle. Each blade should travel across windshield in a position so that when the arm is at the end of its outward sweep, the wiper blade should be parallel with edge of windshield as shown in figure 14. If necessary, adjust angle of blade as follows:

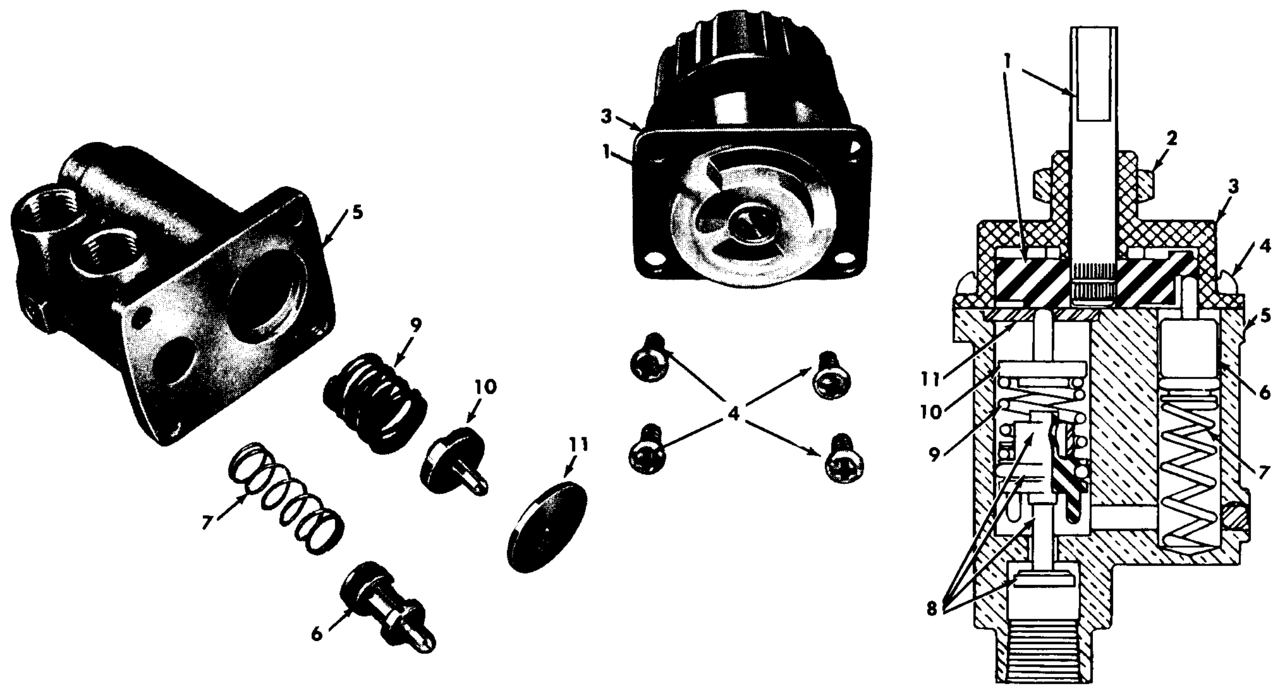
1. Loosen lock nuts on pantograph shaft (fig. 14).
2. Remove crown nut which attaches shaft arm to pivot shaft. Remove shaft arm from shaft, then while holding outer end of pantograph shaft, turn shaft arm to shorten or lengthen overall length of shaft assembly.
3. Reinstall arm on pivot shaft. Force arm and blade across wetted glass and check angle of blade.
4. Repeat adjustment if necessary, then install crown nut on pivot shaft. Tighten nut firmly. Tighten lock nuts on pantograph shaft.

WIPER MOTOR AIR STRAINER

Windshield wiper air strainer (fig. 15), mounted under dash, front of steering column should be removed, disassembled, and cleaned annually. Soak strainer filter in cleaning solvent to clean. Dry filter, then reassemble strainer. Tighten strainer and bushings firmly.

WIPER MOTOR HAND CONTROL VALVE

Individual wiper motor hand control valves can be removed from vehicle for cleaning or repair if necessary. Before removing valve assembly from dash and air lines, exhaust pressure from air supply tank.



EXPLODED VIEW OF VALVE

SECTIONAL VIEW OF VALVE

1 Cam Rod Assy.
2 Lock Nut
3 Cover
4 Cover Attaching Screws
5 Body
6 Parking Valve Stem Assy. (Incl. O-ring)
7 Spring (19/64" O.D.)
8 Valve, Seat, and Retainer Assy.
9 Spring (31/64" O.D.)
10 Pressure Regulating Ram
11 Guide Washer

TPM-8713

Figure 16—Windshield Wiper Hand Control Valve

REPAIR

NOTE: Key numbers in text refer to figure 16.

1. Remove four screws (4) which attach cover (3) to body (5). Separate cover from body as shown.

2. Pull parking valve stem (6) with rubber O-ring from valve body. Remove valve spring (7).

3. Using needle-nose pliers pull pressure regulating ram (10) with guide washer (11) from valve body. Remove spring (9).

NOTE: Valve assembly need not be disassembled further.

4. Clean all parts in solvent, then applying air pressure into valve body ports, blow any dirt and solvent from valve body. Using a wood stick or other soft material, force valve, seat, and retainer assembly (8) back and forth within body, then repeat cleaning procedure. NOTE: If retainer assembly appears damaged the entire hand control valve assembly should be replaced.

5. Apply small quantity of wiper motor grease to valve surfaces and rubber O-rings.

6. Referring to sectional view, assemble valve assembly as shown. Tighten cover attaching screws firmly. Install valve assembly, then check operation.

WIPER MOTOR REPLACEMENT AND OVERHAUL

REPLACEMENT (Fig. 17)

Removal

1. Remove wiper arm linkage at front of windshield. Remove spanner nuts and seal washers from motor linkage shafts.
2. Exhaust pressure from air supply system.
3. Disconnect air lines at wiper motor.
4. Remove two bolts which attach motor bracket to body panel.

Installation

1. Referring to figure 17, place wiper motor with assembled linkage into position and attach to body panel with two bolts and washers. Also at front of vehicle install seal washers and spanner nuts which retain motor shafts in position. Tighten spanner nuts to 18-20 foot-pounds torque.
2. Connect air lines to motor valve ports.
3. Build up air supply (65 psi or more).
4. Operate motor. While observing the cycling of wiper arm shaft, turn wiper off when shaft is located in park position. In this park position en-

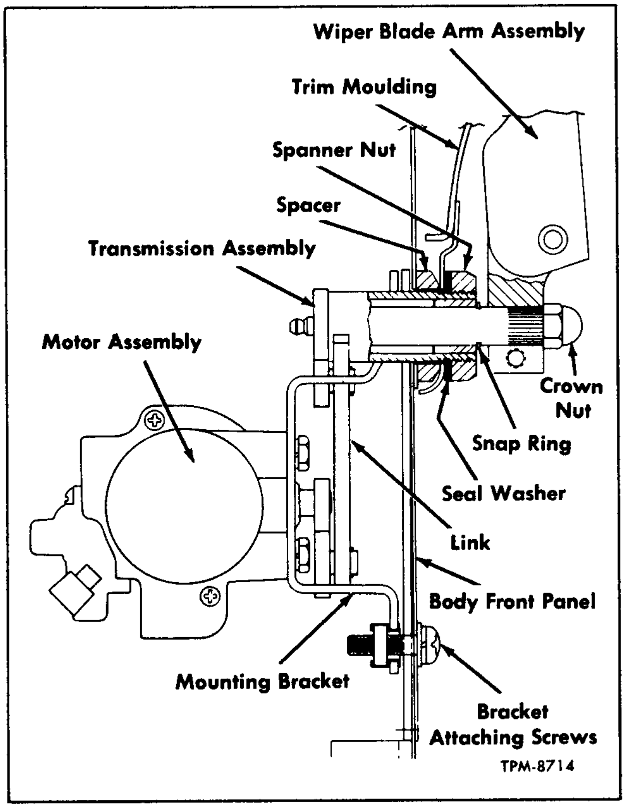


Figure 17—Wiper Motor and Bracket Installation

gage wiper arm over serrations of shaft; at same time install pantograph shaft to pivot shaft. Tighten arm clamp screw and install crown nuts to pivot shaft.

IMPORTANT: Make sure pantograph shaft arm is free to rotate on pivot shaft as too many shim washers under crown nut will cause binding of linkage.

OVERHAUL

NOTE: A kit is available including all necessary parts to properly service motor. Kit includes all items indicated by an asterisk (*) in figure 18, plus 1 oz. of recommended lubricant.

NOTE: All key numbers in following text refer to figure 18.

Separation of Major Sub-assemblies

NOTE: Lower left view of figure 18 shows major subassemblies.

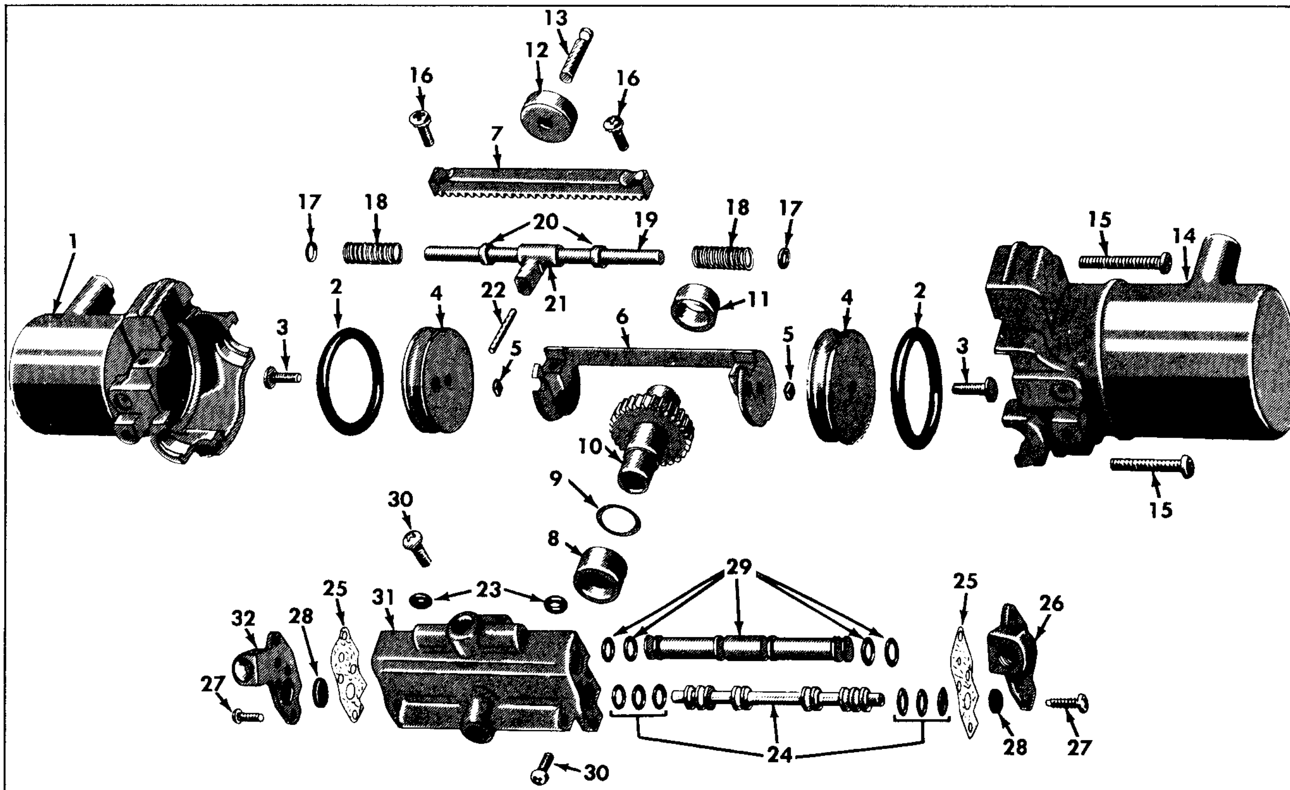
1. Remove retainer (37) which attaches link (36) to motor shaft assembly (35).
2. Remove screw (41) and washer (40) which attach motor transmission shaft (35) into wiper motor. Pull shaft assembly from motor assembly.
3. Remove four bolts (38) which attach mounting bracket assembly (33) to motor. Remove bracket.
4. Remove four screws (30) which attach wiper control valve body (31) to motor piston body assemblies. Remove valve body and body O-rings (23). Figure 19 shows body separated.
5. Place right half of piston body (1) (half with threaded screw holes) in vise so that attaching screws are up. CAUTION: Tighten vise ONLY enough to hold body.
6. Remove screws (15) which attach piston bodies together.
7. Slowly lift off upper piston body (14).
8. Note position of alignment marks ("X") on gear (10) and gear rack (7). Remove gear assembly, noting locations of thick and thin bearings and the chamfer on the rear bearing.
9. Note position of roller pin (13), and remove rack roller (12).
10. Note position of valve reverser tee (21) in body slot, and remove the piston assembly (39).

Build-up of Major Sub-assemblies

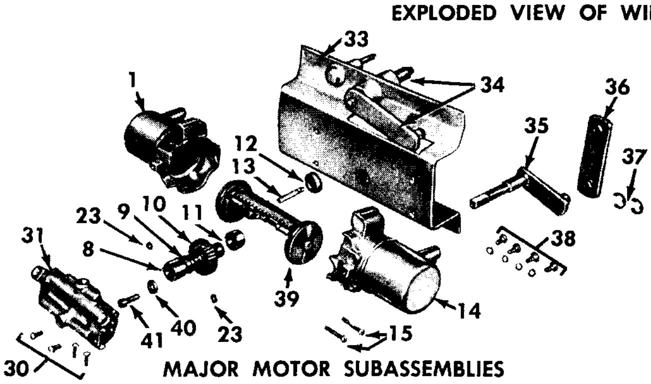
1. Apply clean wiper motor grease to all moving or sliding parts.
2. With right piston body assembly (1) placed in vise, install piston assembly (39) into piston body.
3. Install roller (12) and roller pin (13). Make sure pin notch is properly positioned to align with body attaching screw later.
4. Assemble bearings (8) and (11) with shim washer (9) on gear and sleeve assembly (10). NOTE: Make sure chamfer on rear bearing is toward the rear. Install gear and bearings into body. Make sure alignment marks ("X") on gear and rack are aligned.
5. Install left piston body assembly (14) over piston assembly. Attach bodies together with screws (15). Tighten screws firmly.
6. Referring to figure 19, place O-rings (23) on bosses of valve body (31) as shown. Carefully place valve body to motor piston bodies, then install valve body attaching screws (30). Tighten screws firmly.
7. Attach mounting bracket (33) to motor with four bolts (38) and lock washers.
8. Install motor transmission shaft assembly (35) into motor making sure shaft link is positioned to align with upper wiper arm shaft lever.
9. Install link (36) to shaft and secure with retainer (37).

Wiper Motor Valve Disassembly and Assembly

1. Remove screws (27), then remove parking end plate (26 and 32) and gaskets (25) from valve body (31). Remove disc (28) from end plates.
2. Unscrew valve pin (22) projecting from valve body side.
3. Push out primary (alum.) rod (29) and secondary (nylon) rod (24) from valve body.



EXPLODED VIEW OF WIPER MOTOR ASSEMBLY



MAJOR MOTOR SUBASSEMBLIES

1 R.H. Piston Body Assy.
* 2 Rubber O-Ring
3 Screw Assy.
* 4 O-Ring Adapter
5 Rubber Disc
6 Piston Rack
7 Gear Rack
8 Bearing (Rear)
9 Shim Washer
10 Gear and Sleeve Assy.
11 Bearing (Front)
*12 Roller Rack
*13 Roller Pin
14 L.H. Piston Body Assy.
15 Body Attaching Screws
16 Piston Rack Attaching Screws
17 Steel Washer
18 Spring
19 Turnbuckle Rod
20 Reverser Stop Floating Piston Tubing
21 Reverser Tee
*22 Valve Pin
*23 Valve Body O-Ring
*24 Secondary Rod Assy.
25 Gasket
26 Parking End Plate (R.H.)
27 End Plate Attaching Screw
28 Disc
*29 Primary Rod Assy.
30 Valve Body Attaching Screws
31 Valve Body
32 Parking End Plate (L.H.)
33 Motor Mounting Bracket Assy.
34 Wiper Arm Shaft Assy.
35 Motor Shaft and Link Assy.
36 Link
37 Link Retainers
38 Motor Attaching Bolts
39 Piston Assy.
40 Washer
41 Shaft Retaining Screw

(*) Part of Repair Kit.

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Figure 18—Windshield Wiper Motor Assembly

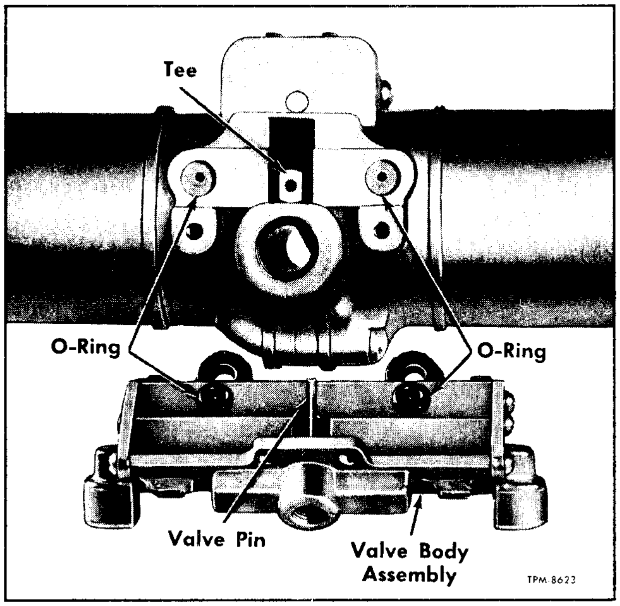


Figure 19—Windshield Wiper Motor Valve Removed

4. Remove rubber O-rings from rods.
5. Clean the valve body, end plates, mounting screws and rods with solvent and wipe rubber O-rings with clean cloth. Examine all parts for wear and defects. Replace all worn and defective parts.
6. Apply wiper motor grease to valve rods and rubber O-rings.
7. Install rubber O-rings on rods, then push rods into valve body. NOTE: Make sure tapped hole in primary rod (29) is in position to align with valve pin (22).
8. Thread valve pin (22) into primary rod.
9. Make sure rubber disc (28) are installed in end plates (26 and 32), then install end plates to valve body with screws (27).

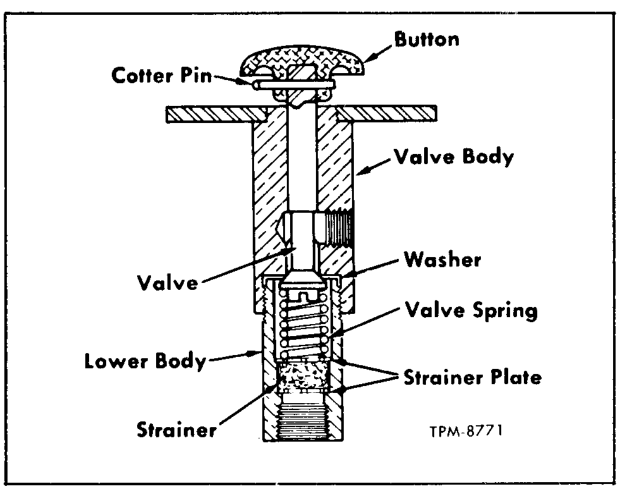


Figure 20—Air Horn Foot Valve

Wiper Motor Piston Disassembly and Assembly

1. Remove rubber O-rings (2) from O-ring adapters (4).
2. Remove screw (3) at each end of piston, then lift off O-ring adapter.
3. Note assembled position of reverser tee (21), springs (18), and steel washers (17), then disassemble components. Reverser stop floating piston tubings (20) are retained to turnbuckle rod (19) with small pin.
4. Note position of assembled gear rack, then remove two screws (16) attaching gear rack (7) to piston rack (6).
5. Clean all parts thoroughly, then examine for wear and abrasion. Replace parts if required. Grease rubber O-rings and gear rack liberally.
6. Attach gear rack (7) to piston rack (6) with two screws (16).
7. Referring to figure 18, assemble tee (21), tubing (20), springs (18), and washers (17) on turnbuckle rod (19) as shown. Install assembly to piston, then attach O-ring adapters (4) to piston with screws (3).

AIR HORNS

Dual air horns are mounted on brackets located in horn compartment. Horns are accessible from underneath left front corner of coach. Air pressure to horns is controlled by driver's foot control valve. Air pressure is supplied by auxiliary air system, obtained in turn, from main air system. Pressure regulating valve in air lines (fig. 13) prevents depletion of main air system by shutting off air to auxiliary air system when pressure in main system falls below approximately 65 pounds.

Refer to BRAKES (SEC. 4) for air line diagrams and information on air lines and connections. Pressure regulating valve maintenance and repair information is also contained in BRAKES (SEC. 4).

REPAIR

Sound is produced by a reed vibrating between two seats.

Horn is non-adjustable, and requires no maintenance.

In the event of horn failure, make sure that air system pressure is at least 75 pounds. Sticking reed may be cause of failure; usually reed can be freed without removing horn from vehicle. Tap horn bells or back of horn while assistant operates driver's foot control valve intermittently. If this fails to free reed, removal and disassembly of the horn is necessary. Seats can be cleaned with a flat oil stone. Since reeds act as air valves, reeds must be flat. If not flat, replace.

FOOT CONTROL VALVE (Fig. 20)

Valve, which controls operation of air horns,

is mounted in driver's floor, with valve body extending downward into tool compartment. Valve requires no maintenance, but can be easily checked for leakage with soap and water solution.

If leakage does occur, valve should be disassembled and lapped, using fine valve grinding compound. After grinding, wash all parts in gasoline and blow with compressed air to remove all traces of grinding compound.

Whenever valve is disassembled, or in event of weak horn action, curled hair strainer in lower body should be cleaned. Lower body is threaded into valve body and is removed by unscrewing.

PASSENGER SIGNAL CHIME

Passenger signal chime (fig. 21) is mounted on front panel at left of steering column. Chime is sounded by two switches, mounted under front ends of package racks. Switches are operated by pull cords at top of side windows. Chime circuit, fed through "DAY" or "NITE" position of coach "MASTER" switch and "CHIME" position of chime switch is shown on "Alarm and Signal Wiring Diagram," at back of this manual.

MAINTENANCE

Solenoid-type chime has no contacts and requires no regular maintenance.

If chime fails to operate, remove chime cover. With "CHIME" switch in buzzer position, check for current indication at both terminals of chime. Current should be obtained at one terminal. Ground other (dead) terminal with jumper wire.

If chime now sounds, check circuit continuity from chime, through switches, to ground. If chime does not sound, make sure plunger operates freely. Disassemble chime as shown in figure 21. Failure may be due to burned out coil, or may be caused by felt positioned in such a manner as to prevent operation of plunger.

If inspection indicates chime is in operating condition, check continuity of current through the passenger signal pull-cord switch. If necessary, remove cover from pull-cord switch as shown in figure 22. Clean terminal and bolt contacts. Inspect switch contacts for loose connections. Operate pull cord and observe mechanism for possible disorder. A short piece of jumper wire placed to each terminal screw will check circuit continuity.

OUTSIDE MIRRORS

Outside mirrors are equipped with replaceable glass sections which can be readily replaced if broken. To prevent breakage of windshield glass, driver's window glass or other window glass by

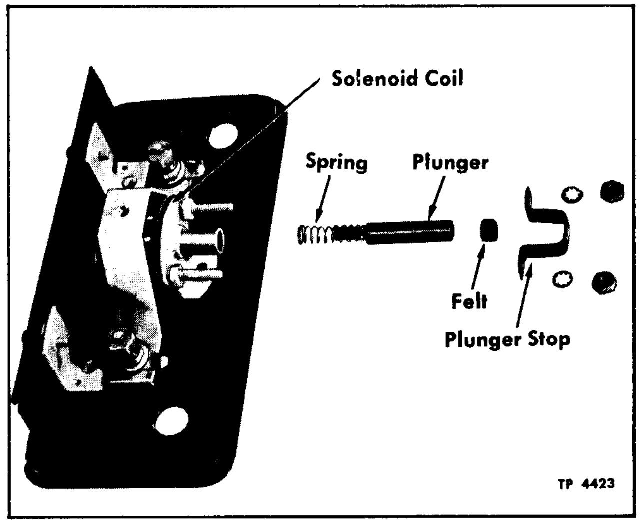


Figure 21—Passenger Signal Chime

sudden slamming or arm or mirror head, adjustable bumper screws are installed in mirror arms (fig. 23) on some coaches. Two bumper screws are employed in right mirror arm and one is employed at rear side of left mirror arm.

Mirror head-to-arm tension and the arm-to-coach bracket tension are adjustable as follows:

MIRROR HEAD TENSION ADJUSTMENT

NOTE: Key numbers in text refer to figure 23.

At bottom of mirror arm (7) tighten or loosen small hexagon socket head screw (6) which will tighten or loosen tension on mirror head ball stud (1). If necessary, mirror arm assembly can be disassembled and tension components repaired or replaced.

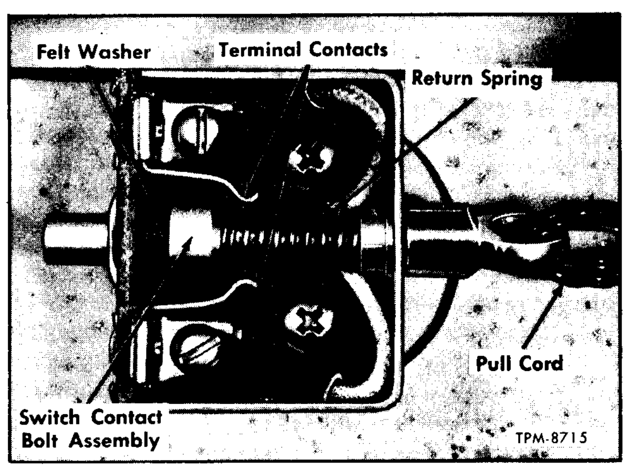
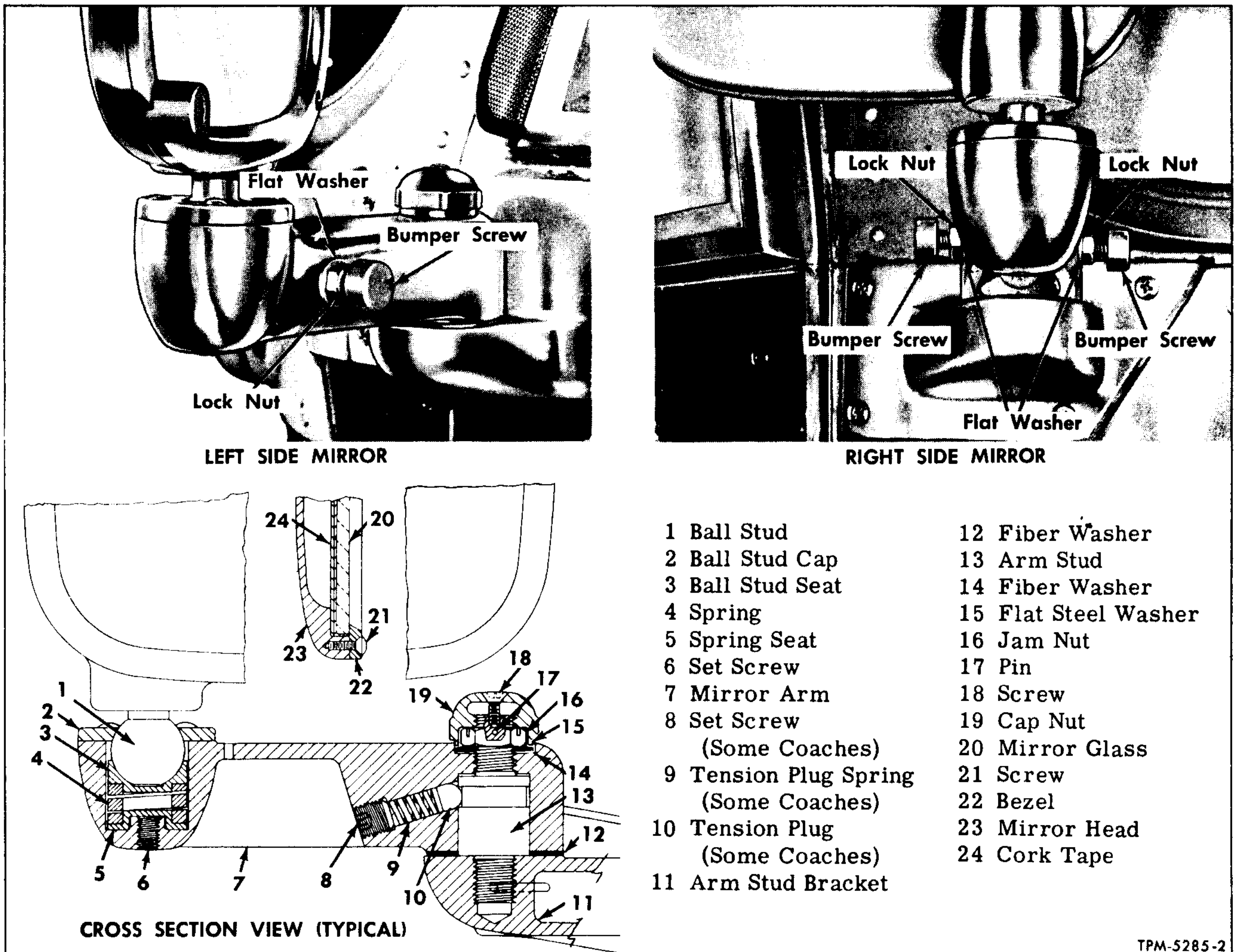


Figure 22—Passenger Signal Chime Cord Switch Cover Removed



1 Ball Stud
2 Ball Stud Cap
3 Ball Stud Seat
4 Spring
5 Spring Seat
6 Set Screw
7 Mirror Arm
8 Set Screw (Some Coaches)
9 Tension Plug Spring (Some Coaches)
10 Tension Plug (Some Coaches)
11 Arm Stud Bracket
12 Fiber Washer
13 Arm Stud
14 Fiber Washer
15 Flat Steel Washer
16 Jam Nut
17 Pin
18 Screw
19 Cap Nut
20 Mirror Glass
21 Screw
22 Bezel
23 Mirror Head
24 Cork Tape

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Figure 23—Outside Rear View Mirror (Typical)

MIRROR ARM-TO-BRACKET TENSION ADJUSTMENT

NOTE: Key numbers in text refer to figure 23.

1. At body end of mirror arm (7), remove small screw (18) retaining cap nut (19) to arm stud (13). Remove cap nut.

2. Remove roll pin (17) from jam nut, then loosen or tighten jam nut to obtain desired tension.

3. If necessary, arm can be disassembled and tension or friction components replaced.

MIRROR ARM STOP ADJUSTMENT
(When Equipped)

Refer to figure 23, upper views.

1. At side of mirror arm, loosen lock nut retaining bumper screw to arm.

2. With mirror arm-to-bracket tension relaxed, swing arm each way to extreme end of travel arc, contacting coach body, windshield, or window glass. Turn out bumper screw to provide sufficient clearance to prevent glass, body or mirror damage. Secure bumper screw by tightening bumper screw lock nut.

DISASSEMBLY OF MIRROR ARM

NOTE: Key numbers in text refer to figure 23.

1. At mirror end of arm, loosen set screw (6) to relieve spring tension on ball stud (1).

2. Remove four screws which attach ball stud cap (2) to mirror arm (7). Remove cap, ball stud (1), ball stud seat (3), spring (4), and spring seat (5) from arm.

3. At bracket end of arm, remove screw (18) attaching cap nut (19) to arm stud (13). Remove cap nut.

4. Remove pin (17) from jam nut (16), then remove nut, flat steel washer (15) and fiber washer (14) from arm stud.

5. On some coaches only remove socket head set screw (8), tension plug spring (9), and tension

plug (10) from mirror arm (7). Remove arm from stud, then remove large fiber washer (12) from arm stud bracket.

ASSEMBLY OF MIRROR ARM

Assemble arm in reverse of disassembly procedures above.

MIRROR GLASS REPLACEMENT

NOTE: Key numbers in text refer to figure 23.

1. Remove eight screws (21) which attach mirror bezel (22) to mirror head (23), then with a thin blade tool pry bezel from head. Wearing gloves to protect hands, remove broken mirror glass (20) and cork tape (24) from mirror head.

2. Install new cork tape (24) around edge of mirror glass and position glass with tape in mirror head. Position bezel (22) over glass to head and secure with eight screws (21). IMPORTANT: Tighten screws evenly and firmly.

At regular inspections of body check for loose rivets or bolts. Make repairs immediately.

SPECIFICATIONS

PASSENGER SIGNAL CHIME

GM Part Number	2164961
Type	Single Tone

Heating and Ventilation

Information contained herein applies to the heating and ventilation system only, and does not cover air conditioning units. However, information on blower used in conjunction with both heating and cooling systems is covered in this group. Throughout text, reference is made to the heating compartment. This compartment is also the cooling compartment but not mentioned as such.

DESCRIPTION

Interior of coach is heated by an underfloor hot water, forced air system (figs. 24 and 25).

The heating controls, however, differ in that some coaches are equipped with standard air-operated controls, while others are equipped with special electrically-operated controls. These controls function to control the flow of water through system, and the operation of these controls is explained later. Some of the control units however, are common to both control systems.

Hot water is supplied by the engine cooling system to a large heater core which is located in the underfloor heating, cooling, and ventilation compartment (fig. 26). Core is accessible after opening wooden closure doors within the compartment. This compartment also encloses the air filter screen, air conditioning evaporator, and the air circulating fan and motor assembly.

A single water flow control valve, which operates automatically, and the water (booster) circulating electric pump assembly are located in the outer portion of this same compartment.

The thermostat or Grad-U-Stat for controlling coach temperature is located in the right recirculating air duct, underneath passenger seat. Some coaches are equipped with a special temperature control rheostat (fig. 27) for selecting desired temperatures within a ten degree range (68^{o}F. to 78^{o}F.). Rheostat is usually mounted on control panel at left of driver.

The coach heating system is used as a reheat system when the air conditioning system is operated. Reheat of cooled air at thermostat demand is automatically furnished whenever the air conditioning system pulls the coach temperature down below the thermostat (or Grad-U-Stat) setting. Thus whenever air conditioning capacity exceeds the cooling requirement, such excess capacity is used to de-humidify the admitted air. The coach temperature remains at the set level by action of the thermostat (or Grad-U-Stat) which controls heat admission to the heater core. Operation of reheat system occurs whenever the coach temperature drops below the selected temperature level.

Defroster heater, located behind dash center closure panel, includes a heater core, two blowers,

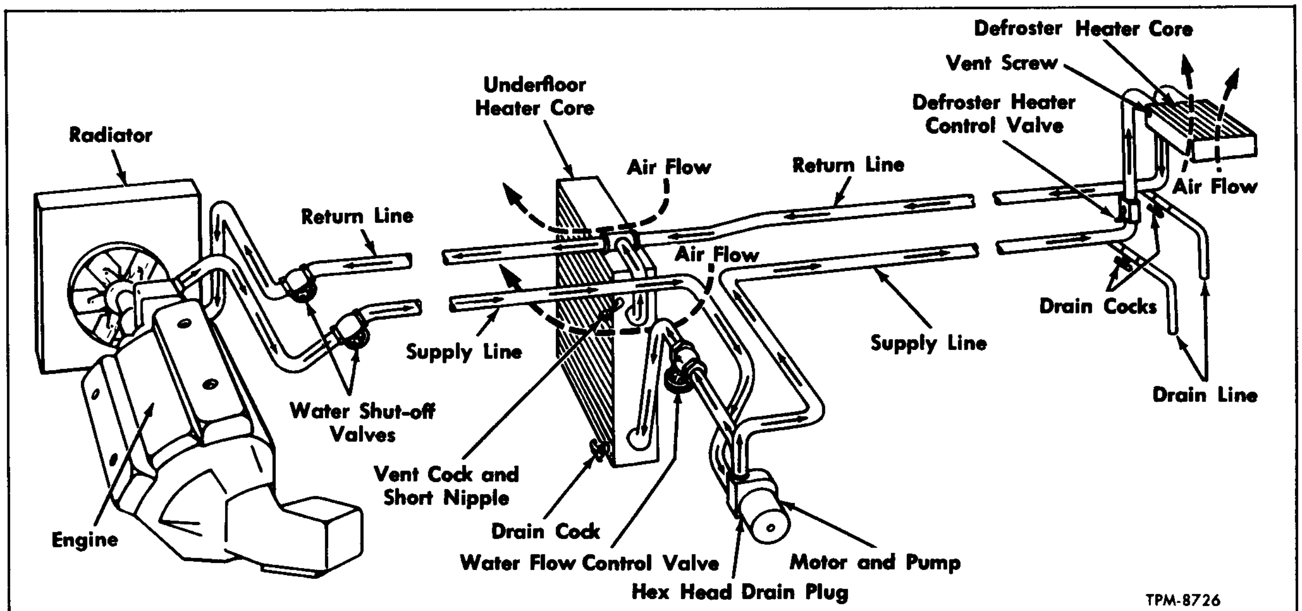


Figure 24—Heating System Water Flow

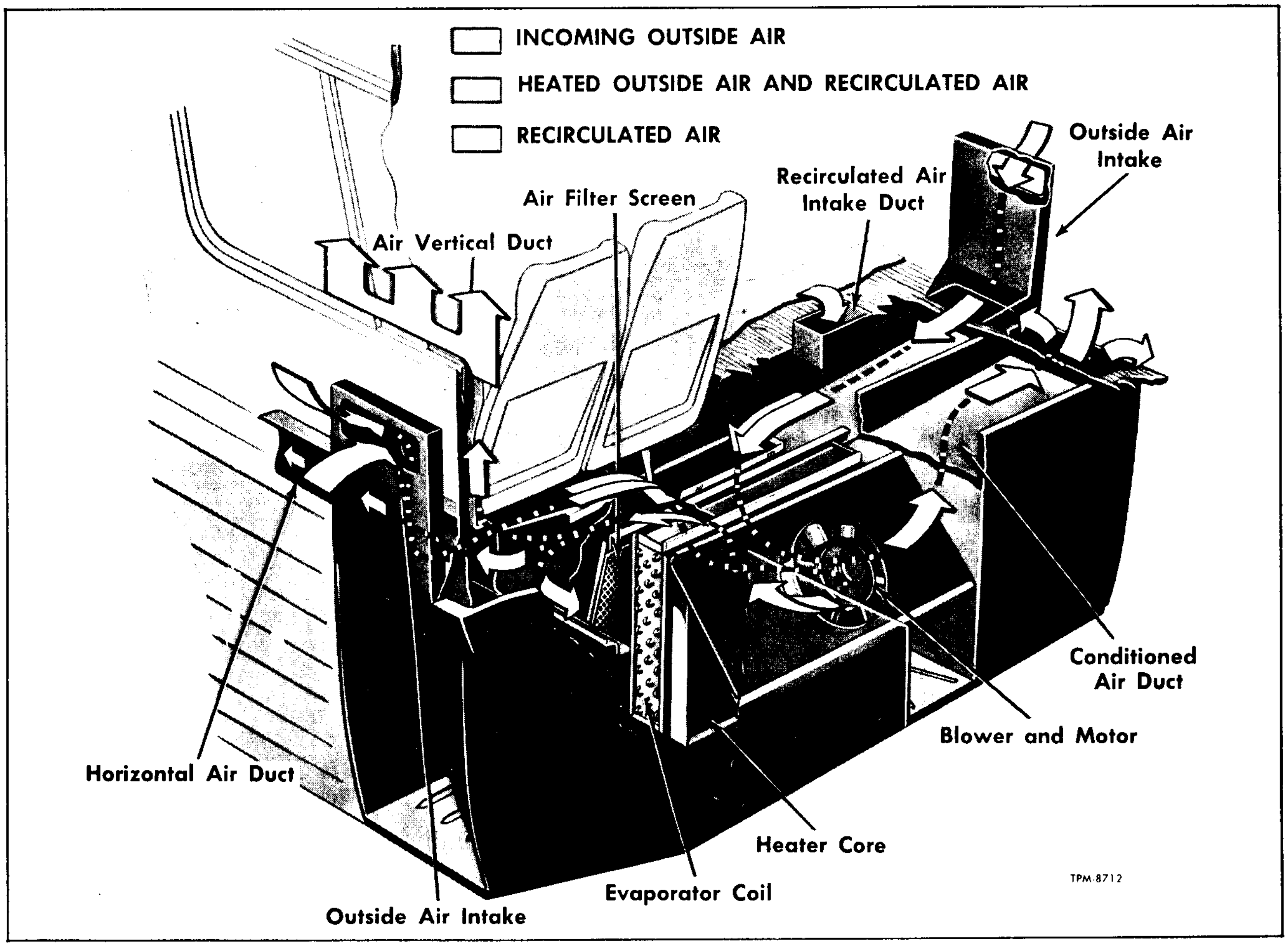


Figure 25—Heating System Air Flow

a dampered outlet for warming driver's feet, and a manually adjusted heater water flow control valve.

Outside air for defrosting or ventilation is admitted to heater by impact or is drawn in by heater blowers. Air enters after positioning cowl vent control handle forward to full-open position.

Handle can be positioned to any degree of opening desired.

With control handle in closed position (pulled rearward) and with heater blowers operating, coach interior air is then deflected over windshield, driver's window, and entrance door window. Defroster heater motors can be operated at either high or low speed as selected by switch marked "DEFROST," "HI," and "LO" on panel at left of driver.

Warm air from the defroster heater compartment can be directed into driver's compartment by means of damper at left side of defroster compartment. Refer to applicable Heating and Air Conditioning Wiring Diagram in back of manual for heating and ventilation circuits.

WATER CIRCULATION

(Refer to Figure 24)

Hot water from the engine cooling system is forced through supply line to heater core by both the engine water pump and the water booster pump. Actual flow of water through the underfloor heater core is controlled by the water flow control valve, and flow of water through the defroster heater core is controlled manually by control valve at right of driver. After circulating through heater core, water flows through the return line back to engine. Warm water from the water booster pump outlet is also routed through a supply line to the defroster heater core at front of coach. Upon passing through core it also returns back to the engine. Two gate valves, one in heater supply line and one in return line, provide means of isolating the heating system from the engine cooling system. This condition could occur in event one system needs to be drained without having to disturb the other. Both valves are located underneath coach floor at rear of rear axle.

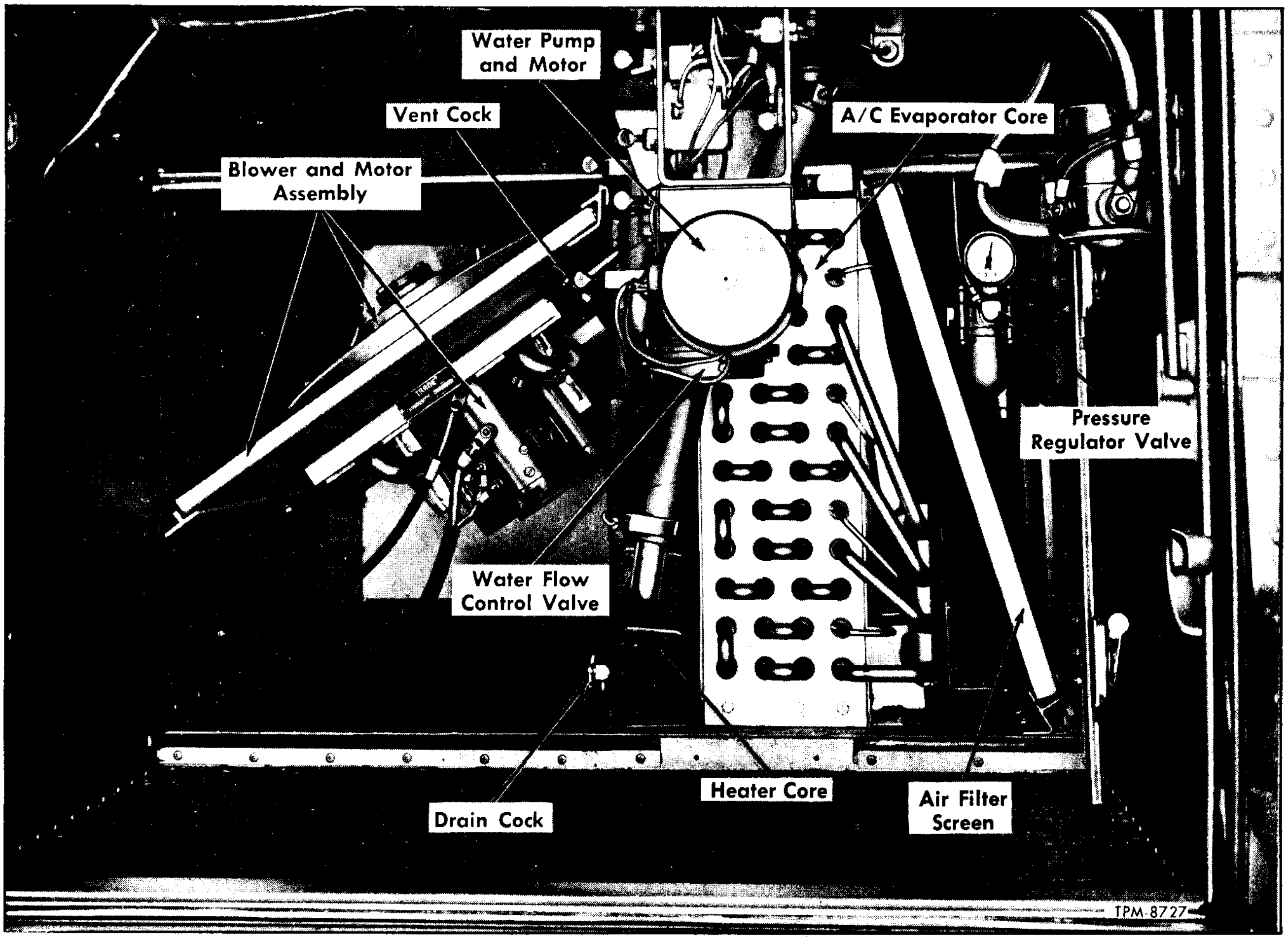


Figure 26—Underfloor Heating and Ventilation Compartment

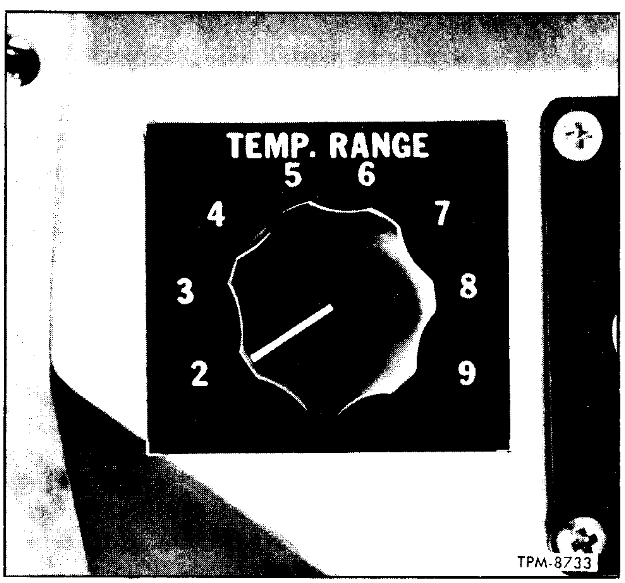


Figure 27—Driver's Temperature Range Selector Control

Booster water pump is energized to circulate water through heating system when the following occurs:

1. When "DEFROST" switch on control panel at left of driver is placed in "HI" or "LO" position while the engine is running.
2. When the air Grad-U-Stat (Std. Heating) or thermostat (Special Heating) calls for heat while the coach engine is running.
3. When the lever of switch installed in the radiator surge tank filler compartment is held upward in "WATER BOOSTER PUMP" position while engine is running.

NOTE: This latter control serves to circulate coolant through the heating system when system is being filled or replenished.

WARM AIR CIRCULATION

(Refer to Figure 25)

The underfloor heater blower motor runs continuously when "VENTILATION" switch is placed in "BLOWER" "HI" or "LO" position while the en-

gine is running. Blower draws outside air into coach heating compartment through perforated openings each side of coach below side windows. Recirculated air within coach is also drawn into heating compartment through two grille-covered recirculating air ducts, under seats one each side of aisle and through openings in front stepwell. Both outside air and recirculated air are distributed through longitudinal ducts along each side at base of wall and up vertical ducts below side windows. Manually operated air outlets in longitudinal ducts at each set of seats (fig. 28), distribute conditioned air over floor and feet of passengers.

Air to left side of driver's seat is admitted into area from longitudinal floor duct, by manually controlled damper which also acts as deflectors.

The air forced through defroster heater core may be all outside air, part outside and recirculated air, or all recirculated air. Selection is obtained by positioning control damper lever under dash at right of driver.

NOTE: Both the main underfloor blower and the defroster blowers tend to pressurize coach, thus forcing some air to exhaust constantly through louvered openings in entrance door.

HEATING SYSTEM CONTROLS

Two types of control systems are used on these coaches to regulate the temperature. The standard air-operated control system and the special electrically operated control system.

Some of the controls however, are common to both control systems.

The various control units are as follows:

CONTROLS COMMON TO BOTH SYSTEMS

Water Booster Pump - Single electric-motor driven pump is installed in heater supply line (figs. 24, 30, and 31). Pump serves to circulate coolant through the heating and defrosting system when heat is in demand.

Defroster Heater Temperature Control Valve - A manually-operated water flow control valve located in supply line near bottom of heater compartment (fig. 51). Pulling upward on control knob opens valve to raise the temperature. Pushing knob downward until it bottoms will close valve completely.

Heater Line Shut-off Valves - Two gate-type water valves (fig. 29), one installed in supply line and one in return line are accessible from underneath coach, at rear of rear axle. Closing of either valve will prevent heating system from functioning. Use of both valves is required to isolate engine cooling system from heating system in event either is to be drained without affecting the other.

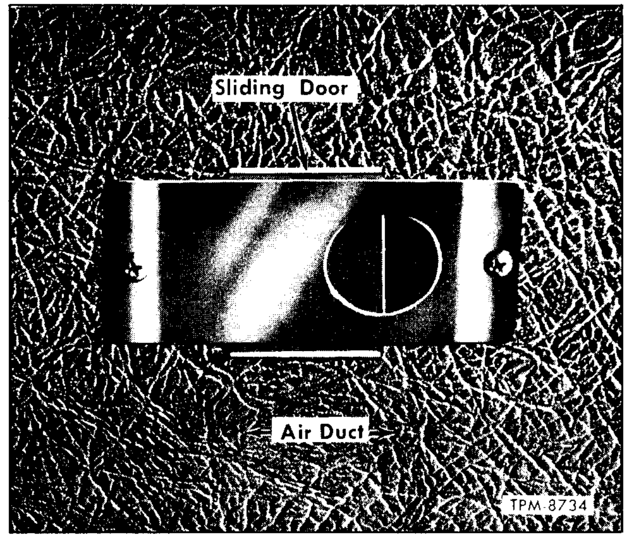


Figure 28—Underseat Air Outlet

CAUTION

Under no circumstances must heating or air conditioning systems be operated when the heating system has been drained; serious damage to the heating system water booster pump seal will occur.

In an emergency, where it is necessary to operate system dry, the electrical wiring at water pump should be disconnected. Tape wiring terminals if exposed to ground.

Temperature Range Control - A special temperature range control (fig. 27) operated by driver to overrule or effect the basic setting of either the air Grad-U-Stat (Standard Heating) or the electric thermostat (Special Heating). Control, mounted on panel at left of driver, regulates the rate of electrical current passing through a small heating element near the thermostat or Grad-U-Stat which senses this radiation and reacts accordingly. Control circuit is described further under "Special Electrical Heating Controls" later.

AIR-OPERATED CONTROLS (STANDARD)

Grad-U-Stat (Thermostat) - A temperature sensing device which regulates the air pressure required to cause air-operated water modulation valve to open or close. Grad-U-Stat is located in the right recirculating air intake under passenger seat (fig. 35). On some coaches, a special small electrical heating unit is installed directly above Grad-U-Stat. When energized by the connected driver controlled rheostat, the heat given off by element will cause bellows of Grad-U-Stat which

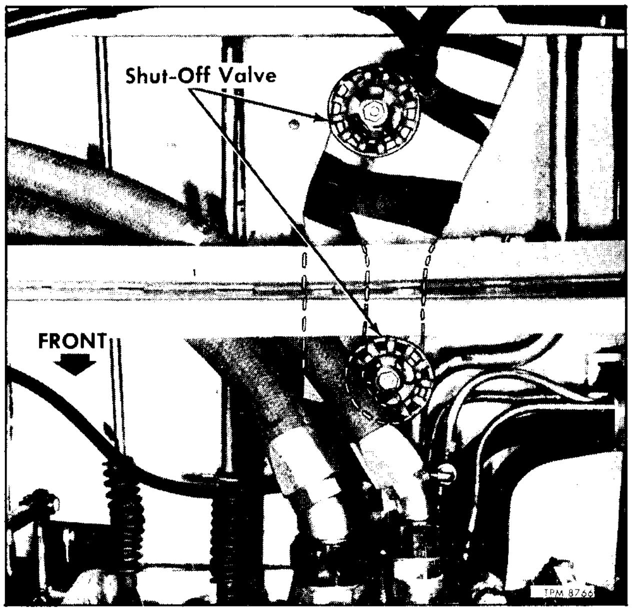


Figure 29—Heating System Water Shut-Off Valves

senses this heat to react accordingly, regulating coach temperature to degree of rheostat setting.

Modulation Valve - An air-operated water flow control valve, mounted in heating system supply line at right side of heater core (fig. 30 or 31). Valve opens allowing water to flow through heating system when air pressure is cut off, by action of the Grad-U-Stat. When air pressure is admitted to water control valve, valve will close, shutting off flow of water through system.

Air Pressure Regulator Valve - A dual-purpose device which strains and regulates the system operating air pressure. Valve, located at front of underfloor heating compartment (fig. 26), maintains a constant pressure of 17 psi to the air Grad-U-Stat.

ELECTRICALLY-OPERATED CONTROLS (SPECIAL)

NOTE: Electrical temperature range control device is described previously under "Controls Common to Both Systems."

Heating Control Relay - Mounted on driver's control panel junction box item 16, figure 4 in ELECTRICAL (SEC. 7). Relay serves to supply or control electrical current to all the other electrical controls of system. Figure 41 shows contents or construction of relay assembly.

Thermostat - A mercury type unit mounted in right recirculating air intake duct as shown in figure 42. Upon rising temperature, thermostat completes electrical circuit between units controlled by the heating control relay.

Electric Water Valve - A solenoid actuated water shut-off valve, connected into heater core supply line. Valve is shown installed in figure 31. Valve opens when de-energized and closes when energized.

NOTE: Detail description and operation of each control unit is explained later under applicable headings. Refer to applicable Heating and Air Conditioning Wiring Diagram in back of manual for control circuits.

MAINTENANCE

GENERAL

1. Heating system and engine cooling system should be flushed semi-annually as described in "COOLING SYSTEM - GENERAL" (SEC. 6).
2. At regular intervals, examine heater pipe joints and fittings, and heater core for leakage and make the necessary repairs. Clean all dirt from heater core.
3. Check for proper operation of heater motor, Grad-U-Stat or thermostat, water valve, switches, and water booster pump at beginning of each heating season.
4. Drain plug is provided at bottom of pressure regulator valve (Standard Heating Controls), for draining collected moisture. Pressure regulator valve is located in underfloor heating and cooling compartment. Valve should be drained at regular intervals.
5. Possible causes of improper heating are explained at end of this section under "Heating System Trouble Shooting Guide."

DRAINING SYSTEM

1. If heating system is to be drained without draining the engine cooling system, close two heater line gate valves below floor at rear of rear axle (fig. 29).
2. Open drain cock at right lower corner of underfloor heater core. Drain cock is accessible through small round access door on the blower compartment closure door.
3. Open two drain cocks in the defroster heater water lines located in compartment below heater core, accessible after opening dash compartment door and reaching down into compartment.
4. Pull knob of defroster heater control valve up to full-open position (fig. 51).
5. Remove drain plug from bottom of water booster pump.

FILLING

1. Make certain all drains and vent cocks are closed, that heater line gate valves are open, and that the defroster heater core temperature control valve is in full open position (control knob pulled upward).

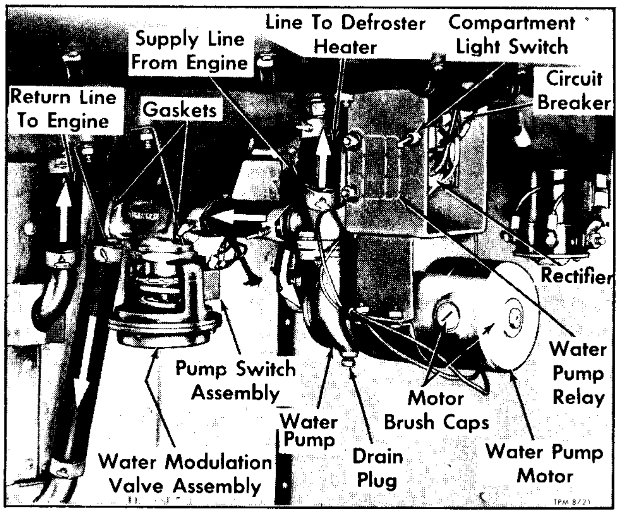


Figure 30—Standard Water Valve and Booster Pump Installed

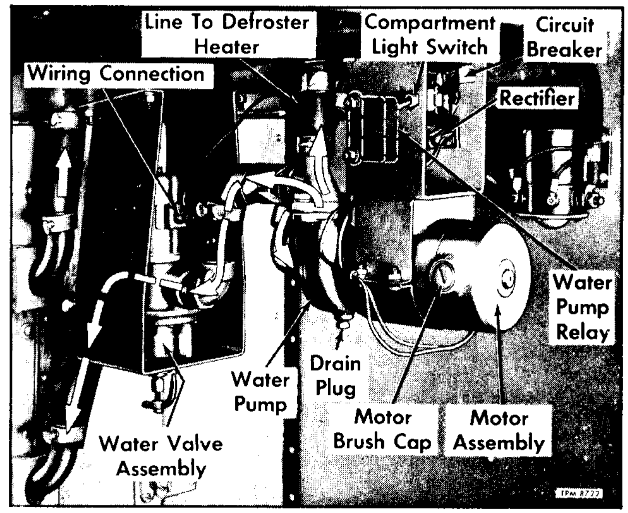


Figure 31—Special Water Valve and Booster Pump Installed

2. Fill heating system in same conventional manner as explained in COOLING (SEC. 6) for engine cooling system.

3. With engine running, operate heating system water booster pump using switch in surge tank filler compartment.

BLEEDING SYSTEM

IMPORTANT: Whenever engine cooling system or the heating system have been drained and then refilled, when system has run low and water is replenished, or whenever sufficient air has accumulated in system to retard normal flow of water, heating system should be bled to expel air.

1. Before bleeding, make sure all drains and vent cocks are closed, that heater line gate valves are open, and that the defroster heater temperature control valve is open (handle pulled upward).

2. As assistant operates the water booster pump using switch in surge tank compartment, open vent cock at upper right corner of underfloor heater core. Open small round access door on blower compartment closure door to reach vent cock. After all air is expelled, close vent. With booster pump still operating, open vent screw at upper left corner of defroster heater core (fig. 51), then close vent when water alone starts to flow.

4. Replenish engine cooling system.

HEATING SYSTEM WATER BOOSTER PUMP

Heating system water pump is mounted in the underfloor heating outer compartment (figs. 30 or 31). Pump operation is explained previously under "Water Circulation."

Refer to "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7) for information on relay used in conjunction with pump motor operation. Pump motor circuits are shown on applicable Heating and Air Conditioning Wiring Diagram at rear of manual.

Adjustment of pump control switch at the water modulation valve as used on coaches with standard air-operated heating controls is explained later under "Switch Adjustment at Water Modulation Valve."

Motor brushes can be replaced without having to remove pump and motor from mounting. For all other servicing remove pump with motor as an assembly. Disassembly of pump is necessary only in case of a seal leak, motor bearing failure, or motor failure.

REMOVAL (Refer to Fig. 30 or 31)

1. Drain heating system to slightly below pump level.

2. Disconnect electrical wiring at motor.

3. Disconnect water lines at flange or hose connections.

4. Remove bolts which attach motor clamp strap to motor mounting bracket. Remove pump with attached motor.

DISASSEMBLY (Refer to Fig. 32)

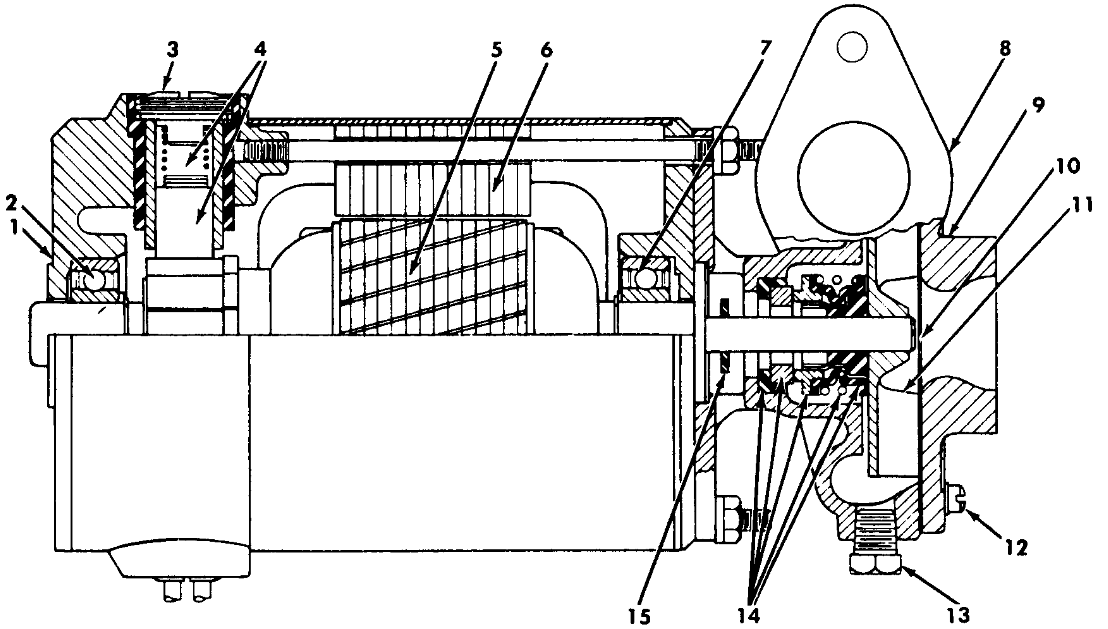
1. Disconnect pump from coolant lines and electrical circuit and remove from installation.

2. Remove two brush caps and two brush and spring assemblies.

3. Remove adapter flange by removing eight fillister head screws. Remove flange carefully to prevent damage to gasket.

4. Remove gasket.

5. Remove two hex nuts, and lock washers



1 Commutator End Frame
2 C.E. Bearing Assembly
3 Brush Cap
4 Brush and Spring Assembly
5 Armature Assembly
6 Stator Assembly
7 Drive End Bearing Assembly
8 Pump Body
9 Pump Cover
10 Pump Cover Gasket
11 Pump Impeller
12 Cover Screw
13 Pump Drain Plug
14 Pump Seal Assembly
15 Rubber Slinger TPM-8768

Figure 32—Water Booster Pump and Motor

which attach pump assembly to motor.

6. Remove pump from motor in the following manner:

a. Install puller tool assembly (Marine Products Co., Part #80-0202) to pump body using four of the screws which were removed from the pump cover.

b. Tighten the puller screw. The puller screw will press the motor shaft out of the impeller hub. The pump proper is now free of the motor.

7. Remove the puller tool.

8. Remove the impeller and components of seal assembly. (CAUTION: Do not damage the raised shoulder of the seal washer.)

9. Remove the floating seal seat from the pump body by gently pressing from the motor side of the body.

CAUTION: Do not scratch or mar the sealing surface of this seat.

INSPECTION (Refer to Fig. 32)

Compare components with new parts to determine degree of wear.

1. Examine motor brushes, and if worn, install new brushes.

2. Rotate motor shaft. If ball bearings show evidence of wear, they should be replaced. Bearings are a tight slip fit on the shaft. Care should be exercised in the placement of the ball bearing on the armature.

3. Check the rubber shaft slinger to make sure it is tight on the motor shaft. If it slips on the shaft it should be replaced.

4. Inspect the seal assembly to determine wear. If the seal has leaked, or is badly worn, installation of a complete new assembly is recommended. However, in an emergency, or if a completely new seal assembly is not at once available, a new component may be installed to replace the damaged member. This procedure should be followed only when a complete new seal assembly is not available.

5. The impeller is a press fit on the armature shaft. This press fit must be maintained to prevent the impeller from slipping. Install a new impeller if necessary.

ASSEMBLY (Refer to Fig. 32)

1. Install floating seal seat in the pump body in the following manner:

a. Clean seat in gasoline or some cleaning solvent to remove any dust or dirt.

b. Insert the seat in the proper recess in the pump body. This is a snug fit, but a drop of machine oil or a small amount of clean grease applied only to the neoprene ring body cavity will insure easy

installation. Be sure the seat bottoms in the pump body around its entire circumference.

2. Install slinger on motor shaft.

3. Assemble body to motor using washers and nuts.

4. Lubricate pump shaft with a small amount of light oil then slip seal bellows and washer assembly onto shaft so that the seal washer contacts the seal seat in the pump body.

5. Install impeller in the following manner:

a. Place impeller on flat surface with vanes against the flat surface.

b. Invert motor and pump body assembly and pilot pump shaft into impeller bore.

c. Press, DO NOT DRIVE on the motor shaft extension at rear of motor until the machined face of pump body is flush with the face of flat surface on which the impeller is resting. The face of impeller vanes must now be flush with machined face of the pump body.

6. Install gasket. This gasket is .010" thick and serves both to seal the cover and to establish proper clearance between the face of the impeller and the pump cover.

7. Attach cover to pump body using eight fillister head screws.

8. Install motor brushes and brush caps.

INSTALLATION OF PUMP AND MOTOR
(Refer to Fig. 30 or 31)

1. Apply gasket cement to pump body line adapters and to line flanges (if flanges were separated). Place pump and motor assembly in position to mounting bracket and secure with clamp.

2. Reconnect line adapter to pump using new gaskets. Make sure connections are tight. If pipes were not separated from pump body, engage hose connections. Tighten clamps firmly.

3. Connect electrical wiring.

4. Fill heating system as previously instructed under "Filling."

IMPORTANT: Make sure pump is positioned inward toward center of vehicle so that compartment door, upon closing will not contact pump motor.

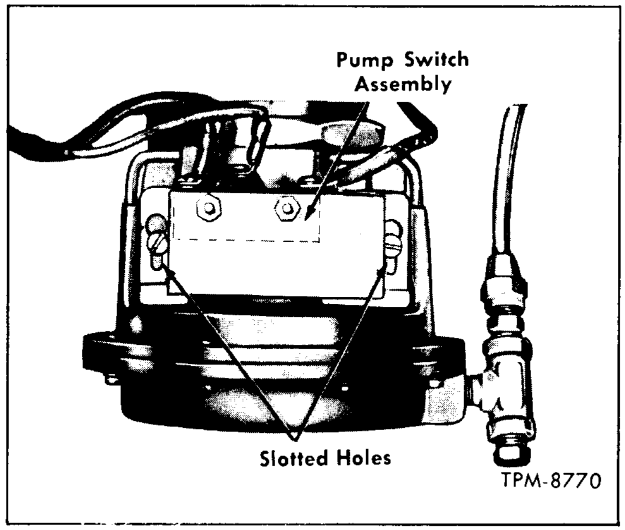


Figure 33—Water Booster Pump Switch Installed on Standard Water Valve

PUMP SWITCH ADJUSTMENT AT WATER MODULATION VALVE (STANDARD CONTROLS)

Switch, which is mounted to front side of water valve (fig. 33) must be located on valve to activate switch contacts, when water valve opens. When valve opens, switch tab engages valve stem to activate switch. Switch position is adjustable by means of two screw slots at switch bracket. Loosen two screws which attach switch bracket then reposition switch as required. Tighten screws firmly after making adjustment.

NOTE: Closing and opening of switch contacts during adjustment can be checked by referring to applicable Heating and Air Conditioning Wiring Diagram in back of this manual.

STANDARD AIR-OPERATED HEATING CONTROLS

GRAD-U-STAT

DESCRIPTION

Grad-U-Stat (fig. 34), which is a thermostatically air-operated control valve, is installed in recirculated air inlet located under seat, at right side of coach (fig. 35). Two air lines connect to unit. Main air line, connected to left port is the main feed line from air pressure regulating valve, which limits the air pressure to 17 lbs; right line carries air pressure from unit to the water modulation valve.

Vapor filled temperature bellows in unit is sensitive to inside coach temperature. Expansion and contraction of bellows, caused by increasing and decreasing coach temperature, is transmitted to air control valves in forward portion of unit through levers.

On some coaches, an additional factor also controls the operation of Grad-U-Stat. An electrical heating element directly above Grad-U-Stat acts upon the unit temperature sensing bellows. Figure 35 shows heating unit installed. Current through heating element is controlled by the "TEMP-RANGE" selector control operated by the driver.

An auxiliary bellows, unaffected by temper-

HEATING AND VENTILATION

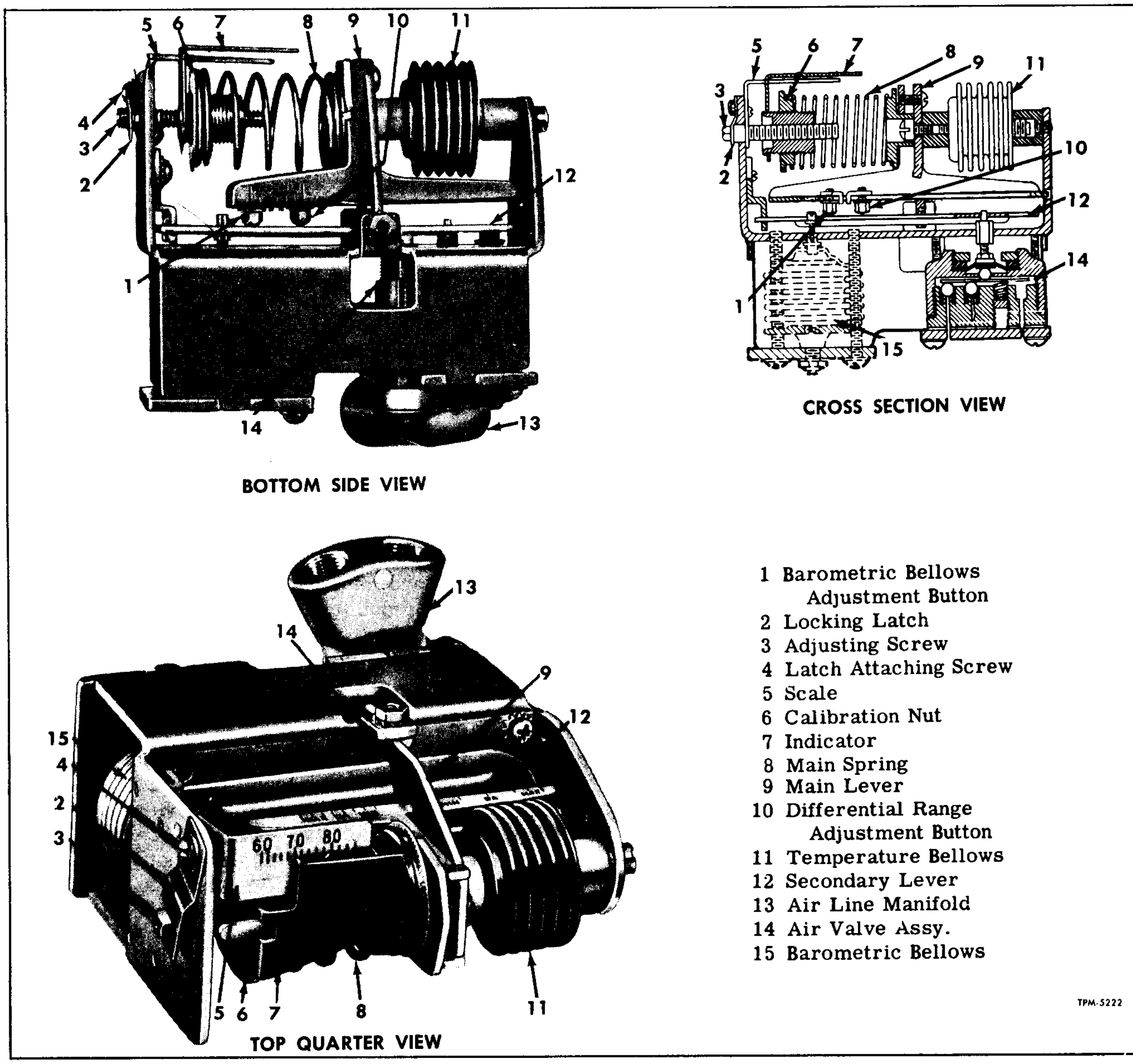


Figure 34—Standard Heating System Grad-U-Stat (Standard Controls)

ature changes, opposes the effect of altitude changes on the temperature sensing bellows.

OPERATION

NOTE: Key letters in text refer to figure 36, however, throughout explanation of Grad-U-Stat Operation, reference is made to simplified diagrams shown in figure 37 which illustrate reaction of Grad-U-Stat under varied temperature conditions.

As temperature in coach rises, bellows (A) expands and exerts downward force on secondary lever (C) through main lever (B) and adjusting button (D). Downward movement of secondary lever is trans transmitted to lever (E) in air control chamber (F) of unit, increasing air pressure delivered to water modulation valve as shown in diagram A, figure 37. This increased air pressure at the modulation valve causes the valve to close, reducing the flow of water through the underfloor heater core.

When temperature in coach lowers, the bellows (A) contract and relieves pressure exerted in air control valve lever (E). Air valve then exhausts air pressure from water modulation valve, increasing the flow of water through the underfloor heater core as shown in diagram B, figure 37. The air pressure delivery by the Grad-U-Stat varies in proportion to the inside coach temperature act-

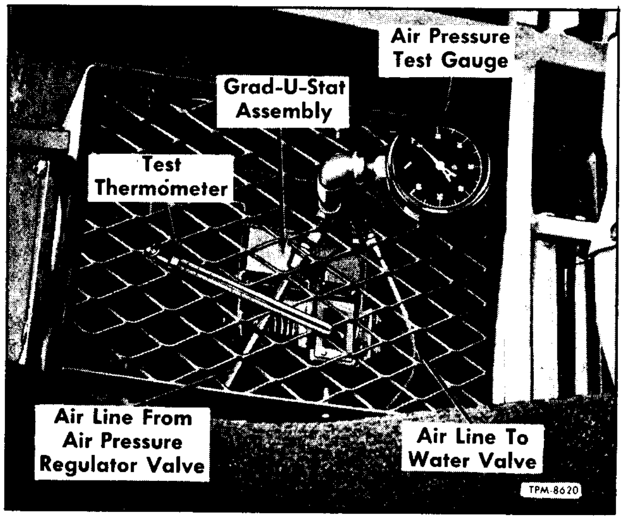


Figure 35—Grad-U-Stat with Test Thermometer and Air Pressure Gauge Installed (Standard Controls)

ing upon the bellows; thus, flow of water through underfloor heater core is graduated as required in accordance with inside coach temperature. Diagram "C" figure 37, shows status of Grad-U-Stat when temperature in coach is approximately equal to temperature setting on Grad-U-Stat.

The differential range adjustment button (10, fig. 34) on the main lever is set at the factory to provide a 6°F. differential between fully closed and fully opened position. This setting has been found satisfactory for most operations and it is recommended that setting not be changed.

Grad-U-Stat is also altitude compensated, providing uniform temperature control when coach is operating at various elevations. An auxiliary bellows (15, fig. 34), unaffected by temperature changes, opposes the effect of altitude changes on the temperature-sensing bellows by retarding action of the secondary lever.

If air inlet screen, under seat, becomes clogged, flow of air over coils of Grad-U-Stat will affect efficiency of unit.

MAINTENANCE

1. Brush away all loose dirt or dust, especially from heating element (if used). If operation is restricted by corrosion or foreign material that cannot be brushed away, clean unit with a solvent, such as trichlorethylene. Recalibrate the Grad-U-Stat if the adjustments have been disturbed. See "Test and Adjustment" later.

2. Inspect the bellows. Dust will insulate the bellows and cause sluggish action.

3. Check the adjustment screw for binding; if it turns hard, clean, then coat it lightly with lubricant. Reset adjustment screw after lubricating.

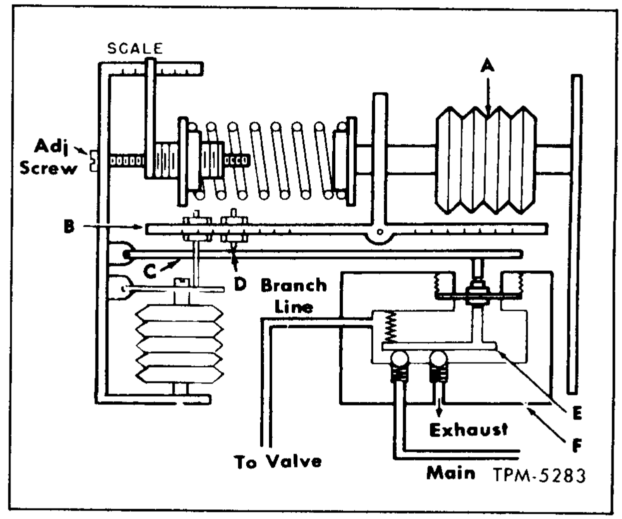


Figure 36—Grad-U-Stat Diagram (Standard Controls)

TEST AND ADJUSTMENT

Key numbers in text refer to figure 34.

1. Shut off air supply to Grad-U-Stat at pressure regulator valve located at front of underfloor heating compartment (fig. 38). Turn regulator screw completely counterclockwise to shut off air.

2. Remove plug from line elbow at Grad-U-Stat, then install air pressure test gauge in this circuit (fig. 35).

3. Open air supply to unit by turning air pressure regulator valve screw clockwise, until pressure gauge at air pressure regulator valve indicates 10 lbs. pressure.

4. Check the air temperature at the bellows with an accurate thermometer (fig. 35). IMPORTANT: Do not touch the bellows with hand while accomplishing the following operation, as body heat will affect both units and erroneous readings and adjustments will be obtained.

5. Through grille in side of air inlet riser, loosen locking latch screw (4), disengage latch (2) from adjusting screw (3), then turn the adjusting screw to set the indicator at the temperature shown on the thermometer.

6. Observe pressure reading on air pressure test gauge. If reading is 4-1/2 pounds, no adjustment is required. If pressure is above 4-1/2 pounds, turn the calibration nut (6) and main spring (8) to shorten the spring until the correct reading (4-1/2 pounds) is obtained. NOTE: Compress spring when turning nut against increased spring compression. Release hand pressure on spring when checking readings. If pressure is below 4-1/2 pounds, turn calibration nut and main spring in opposite direction to lengthen the spring (spring compression not necessary).

7. After correct adjustment is obtained, turn adjusting screw (3) to set the indicator at desired

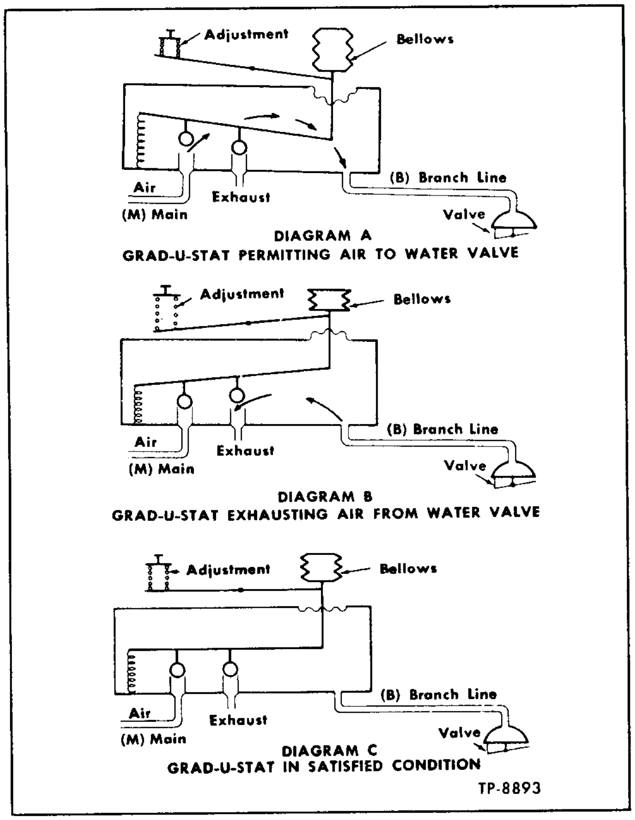


Figure 37—Grad-U-Stat Operational Diagram (Standard Controls)

operating temperature (75°F. is factory setting), place locking latch (2) over adjusting screw, and tighten latch screw (4).

8. To check the differential range, find the temperature setting at which the pressure in line

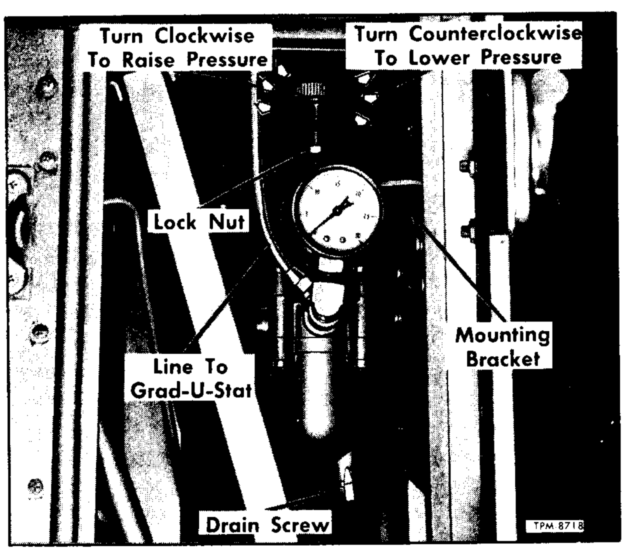


Figure 38—Air Pressure Regulator Valve Installed (Standard Controls)

to water valve is 3 psi and the temperature setting at which line pressure is 10 psi. The number of degrees the setting must be changed to raise line pressure from 3 to 10 psi is the approximate differential range. If necessary, change as follows:

a. Using a small open-end wrench, loosen the differential range button (10, fig. 34). Move the button to the desired position on its scale, and retighten range button. NOTE: To perform this operation, remove the screen from air inlet.

b. Make sure differential range button is between the MAX. and MIN. markings on side of main lever (9, fig. 34). Maximum range is 10 degrees, minimum range is 3 degrees.

9. Remove test gauge and plug in air line tee.

10. Install screen in recirculated air inlet.

11. Open air supply to Grad-U-Stat by adjusting the air pressure regulator valve.

REMOVAL OF GRAD-U-STAT (Fig. 35)

1. Shut off air supply to Grad-U-Stat at regulator valve (fig. 38) by turning regulator screw completely counterclockwise.

2. Remove grille from over Grad-U-Stat. Mark lines in relation to fittings, then disconnect air lines from unit.

3. Remove screws which attach unit to recirculated air inlet riser.

4. Remove screws which attach unit to mounting brackets.

INSTALLATION OF GRAD-U-STAT (Fig. 35)

1. Attach Grad-U-Stat to mounting bracket with screws; then install unit with mounting bracket to recirculated air inlet riser.

2. Connect lines to Grad-U-Stat.

3. Test Grad-U-Stat operation, and adjust if necessary. Complete the installation as previously directed under "Test and Adjustment."

WATER MODULATION VALVE

Water modulation valve (fig. 39) is an air operated water control valve installed in heater water supply line (fig. 30). Valve is accessible after opening door of right forward compartment.

Water modulation valve controls the flow of water through the heater core in accordance with the air pressure delivered to it by the Grad-U-Stat. Valve will start to close when subject to approximately three pounds air pressure, and will be fully closed at approximately 12 pounds pressure.

MAINTENANCE

1. Visually inspect for broken or kinked air line and broken or damaged parts.

2. Apply soapy water to air line connection and to exposed edges of diaphragm. Unless coach is abnormally cold, leakage will be indicated by bubbles.

3. Use compressed air to blow dust and dirt from area around spring. Cleaning solvents such as trichlorene may also be used.

4. Check the valve packing for leakage.

NOTE: The packing nut (4, fig. 39) is self-adjusting; excessive tightening will not stop packing from leaking. The packing nut must however, be threaded completely into bonnet.

5. If leakage cannot be stopped, repack valve as explained later under "Repacking Valve."

REMOVAL OF MODULATION VALVE

1. Shut off air supply to valve by turning regulating screw at pressure regulator valve completely counterclockwise; then disconnect air line and pump switch wiring from modulation valve.

2. Drain heating water system as previously directed under "Draining."

3. Remove four screws which attach valve to water line flanges. Remove valve assembly from between line flanges.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 39.

1. Unscrew valve bonnet (9) with valve mechanism from valve body (13).

2. Using a screwdriver through opening in spider (17), pry stem coupling lock (21) in or out to uncouple stem (3) from lock.

3. Place mark on cover (1) and outer spider (17) to assure assembly of parts in correct relationship; then remove screws (2) which attach cover to valve outer spider. Remove cover, diaphragm (23), diaphragm push plate (22), coupling lock (21), outer spring seat (20), spring (18) and spring inner seat (5) from valve.

4. Remove two set-screws (7) which secure spider (8) to bonnet (9).

5. Outer spider (17) can be separated from inner spider (8) after removing two attaching screws (6).

6. Measure over-all length of stem assembly including stem button (19) and valve guide (12), to reassure adjustment to same length at time of assembly.

7. Using a nail in small hole of valve stem to hold stem from turning, thread stem button (19) from end of stem.

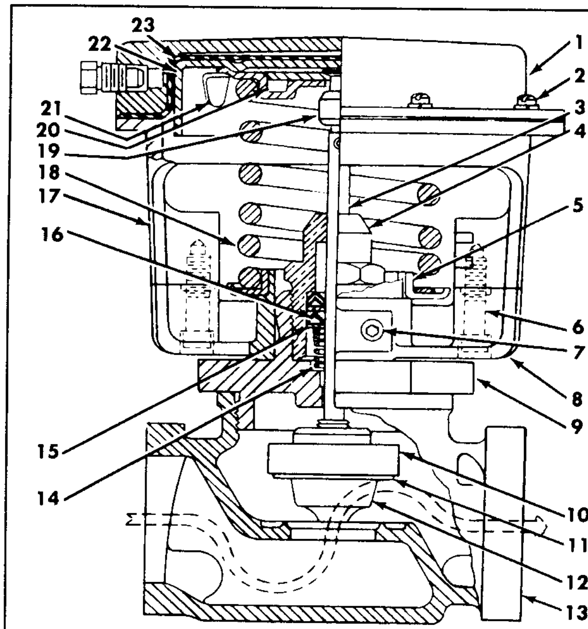
8. Unscrew packing nut (4) from bonnet (9); then slide packing nut with packing (16) from stem. Remove packing washer (15) and packing spring (14). Remove packing from packing nut.

9. Turn valve holder (10), valve disc (11), and valve guide (12) from end of stem.

ASSEMBLY

NOTE: Key numbers in text refer to figure 39.

1. Clean and inspect all parts before assembling valve. If any parts are worn, replace.



1 Cover	13 Valve Body
2 Cover Screws	14 Packing Spring
3 Valve Stem	15 Packing Washer
4 Packing Nut	16 Packing Ring
5 Spring Inner Seat	17 Outer Spider
6 Screw	18 Return Spring
7 Set Screw	19 Stem Button
8 Inner Spider	20 Spring Outer Seat
9 Bonnet	21 Coupling Lock
10 Valve Holder	22 Push Plate
11 Valve Disc	23 Diaphragm
12 Valve Guide	

TPM-5221

Figure 39—Water Modulation Valve (Standard Controls)

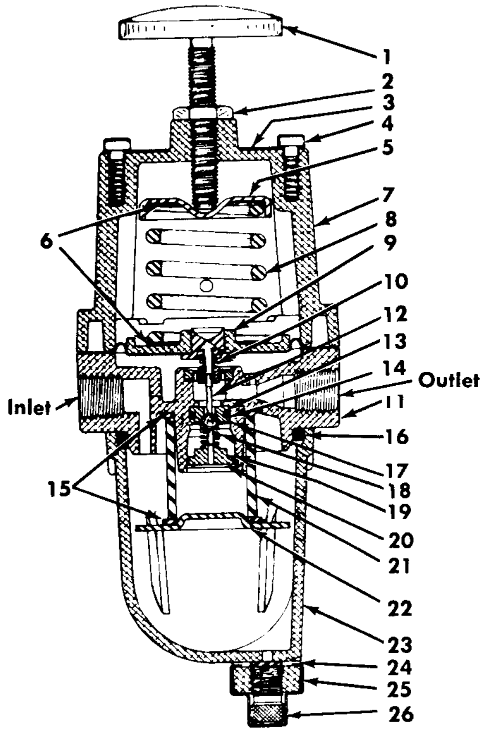
2. Assemble valve holder (10), valve disc (11) and valve guide (12) on end of valve stem (3) and tighten firmly.

3. Apply light silicone lubricant to packing rings and to interior of packing nut, then insert stem through bonnet (9) and install packing spring (14), packing washer (15), one packing ring (16), another packing washer, remaining two packing rings (16), and packing nut (4) onto valve stem in sequence mentioned. NOTE: Turn packing rings on valve stem threads with the spot of paint on each ring facing outward from valve body. Rings must be positioned as shown in figure 39. Thread packing nut into bonnet (9) and then tighten nut firmly.

4. Thread stem button (19) on end of valve stem to a distance whereby overall length of stem with stem button and valve guide equals measured length recorded prior to disassembly.

5. Attach outer spider (17) to inner spider (8) with two screws (6); then position spiders over bonnet (9) and secure with two set screws (7).

6. Position valve return spring inner seat (5),



1 Adjusting Screw
2 Lock Nut
3 Name Plate
4 Screw
5 Spring Guide Plate
6 Spring Cushion (Cork)
7 Regulator Cover
8 Spring
9 Diaphragm Assy.
10 Bleed Spring
11 Valve Body and Diaphragm Assy.
12 Inner Valve
13 Seat
14 Seat Gasket
15 Filter Gasket
16 Body Gasket
17 Snap Ring
18 Inner Valve Spring
19 Valve Guide
20 Guide Snap Ring
21 Filter
22 Filter Seat
23 Bowl
24 Drain Screw Disc
25 Drain Screw Retainer
26 Drain Screw

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Figure 40—Air Pressure Regulator Valve Assembly (Standard Controls)

return spring (18), and spring outer seat (20) over valve stem in sequence mentioned then compress spring and engage coupling lock (21) on end of stem.

7. Position diaphragm push plate (22) over outer spring seat; then position diaphragm (23) over push plate. While holding valve in closed position (compress stem return spring), install cover (1) over diaphragm and spider. Align marks on cover and spider made prior to disassembly and attach with cover screws (2). Tighten screws firmly.

8. Screw bonnet (9) and valve mechanism into valve body (13); then tighten bonnet firmly.

INSTALLATION OF MODULATION VALVE
(Refer to Fig. 30)

1. Arrow on valve body indicates direction of water flow through valve. Valve must be installed with arrow on valve body pointing toward heater core.

2. Position valve assembly with new flange gasket at each valve flange, up between water line flanges. Install four cap screws through water line flanges, mounting bracket, flange gaskets, and thread into valve flanges. Tighten cap screws evenly and firmly.

3. Connect air supply line to cover of valve. Open air supply to valve, by turning regulator screw on pressure regulator valve, clockwise until pressure gauge at regulator valve indicates 17 lbs. pressure. Connect water booster pump wiring to switch.

REPACKING VALVE

NOTE: Key numbers in text refer to figure 39.

NOTE: It is not necessary to remove valve assembly to repack valve. Drain system to point of valve level.

2. Force the coupling lock (21) away from locked position with a screwdriver.

3. Loosen two spider set screws (7), then pull actuator unit (diaphragm, spring, and spiders) from valve bonnet.

4. Unthread stem button (19), exercising care not to disturb small set screw in end of stem button. Insert pin in small 1/16" hole just below stem button to hole stem while removing button.

IMPORTANT: Do not mar stem.

5. Thread packing nut (4) from bonnet (9). Remove spring (14) packing washers (15) and packing rings (16) from packing nut.

6. Clean and polish valve stem (3) if necessary with trichlorethylene and crocus cloth. Rub the stem lengthwise with cloth.

7. Dip the new packing rings in a light silicone lubricant and allow to drain. Also coat valve stem and inside of packing nut with lubricant.

8. In the following sequence, install packing spring (14) one steel packing washer (15), one packing ring (16), another packing washer (15) and remaining two packing rings on valve stem.

NOTE: Turn packing rings over stem threads, with the spot of paint on each ring facing outward from valve body.

9. Replace the stem button (19) on valve stem. Tighten button firmly. Do not disturb set screw in stem button.

10. Reinstall the actuator units as directed previously under "Assembly" of valve.

11. Fill system, then check operation of valve.

AIR PRESSURE REGULATOR VALVE

Air pressure regulator valve (fig. 40) is mounted on bulkhead at front of underfloor heating and cooling compartment (fig. 38). Valve is accessible after opening inner front closure door. Valve serves two purposes, to strain the air of dirt and moisture and to regulate air pressure to Grad-U-Stat. As the Grad-U-Stat uses the compressed air, the regulator valve admits additional compressed air, thus maintaining a constant pressure at Grad-U-Stat. Air pressure at Grad-U-Stat should be 17 lbs.

Should there be a constant bleeding of air through vent hole in the regulator cover (7, fig. 40), the inner valve assembly should be checked. Foreign matter may be lodged in valve seat or the valve may be worn.

ADJUSTMENT (Refer to Fig. 38)

When adjusting air pressure regulator valve, always observe air pressure reading on air pressure gauge at regulator valve outlet. To adjust valve, loosen lock nut at top of valve unlocking valve adjusting screw. Turn adjusting screw counterclockwise to lower air pressure output. Adjusting screw in complete counterclockwise position will shut off air pressure entirely. To raise air pressure output, turn adjusting screw clockwise until desired air pressure output is indicated on air pressure gauge at valve. Air pressure gauge should be checked occasionally using test gauge to check accuracy of valve gauge.

DRAINING

Drain regulator valve at regulator intervals to expell collected moisture by turning out drain screw (fig. 38) at bottom of valve.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 40.

1. Loosen lock nut (2) which secures adjusting screw (1) in regulator cover (7). Turn out adjusting screw from cover.
2. Scratch or mark side of regulator cover (7), valve body assembly (11) and bowl (23) to assure original alignment at assembly. Remove four screws attaching these units together.
3. Remove regulator cover (7), spring guide plate (5), cushion (6), spring (8), another cushion (6), diaphragm assembly (9), and small bleed spring (10) from valve body (11).
4. Separate valve body (11) from bowl (23). Remove body gasket (16) from valve body, then remove filter (21), filter gaskets (15) and filter seat (22) from filter body.
5. Inner valve (12), valve spring (18) and valve guide (19) can be removed from valve body after removing guide snap ring (20) from body.
6. Remove snap ring (17), then using a small hooked tool pull inner valve seat (13) with seat gasket (14) from valve body (11).

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 40.

1. Clean all parts except diaphragm (9) and valve body assembly (11) with cleaning solvent. Wipe diaphragm and valve body with clean cloth. Clean filter (21) using compressed air directed from inside of filter.
2. Make visual inspection of valve body (11) and bowl (23) for cracks and breakage. If diaphragm in valve body is cracked, it will be necessary to replace complete valve body and diaphragm assembly.
3. Replace springs indicating evidence of corrosion, fracture, or weakness.

ASSEMBLY

NOTE: Key numbers in text refer to figure 40.

1. Position drain screw disc (24) in bowl, then install drain screw (26). Install drain screw retainer (25) over drain screw to body.
2. Lower filter seat (22) with rubber gasket (15), filter (21), and another gasket (15) into bowl (23).
3. Place seat gasket (14) into groove of valve seat (13). Press seat with gasket into valve body and install retaining snap ring (17). Refer to illustration for position of parts.
4. Position body O-ring gasket (16) over shoulder of valve body (11).
5. Insert inner valve (12), valve spring (18) and valve guide (19) in valve body and retain with guide snap ring (20). Refer to illustration for proper positioning of parts.
6. Lower valve body assembly over filter to bowl.
7. At top of valve body, position small bleed spring (10) over protruding needle point.
8. Position diaphragm (9) to valve body making sure center of diaphragm engages valve needle in valve body.

   NOTE: Top side of diaphragm has lipped-seat for engaging main spring (8).
9. Install main spring cushion (6) in spring seat of diaphragm, then install main spring (8), another cushion (6) and spring guide plate (5).
10. Lower regulator cover (7) down over spring to valve body. Align marks made prior to disassembly on bowl, valve body, and regulator cover. Make sure screw holes in diaphragm are also aligned. Install four screws attaching units together. Tighten screws evenly and firmly.
11. Thread lock nut on adjusting screw (1), then thread adjusting screw into regulator cover. Adjust regulator as directed previously under "Adjustment."

SPECIAL ELECTRICAL HEATING CONTROLS

HEATING CONTROL RELAY

Heating control relay (fig. 41) is mounted in driver's control panel junction box located at lower left side of driver. Relay is accessible after closure panel is removed as shown in figure 4 in ELECTRICAL (SEC. 7A). See item 16.

Control relay has three stationary contacts and three movable contacts. Movable contacts are attached to arms connected to relay armature. Refer to Heating and Air Conditioning Wiring Diagram (MD89320) at back of manual which shows circuits through relay.

With thermostat dissatisfied (relay coil de-energized), movable contacts rest against the two upper stationary contacts. When thermostat becomes satisfied, circuit through relay coil is energized and the armature is attracted to core of coil. Movable contacts attached to armature are forced down against the two lower stationary contacts. With engine running, current is fed from one side of water booster pump switch to the heating control relay.

With thermostat dissatisfied current flow is as follows: Through movable contacts and through upper stationary contact at inner side of coil, through the CR1 resistor, to junction No. 79; then through thermostat heating element to ground. Current also is carried to the feed side of relay coil through resistor lettered LL to junction No. 48, through heating control rheostat, then through the thermostat heating elements to ground.

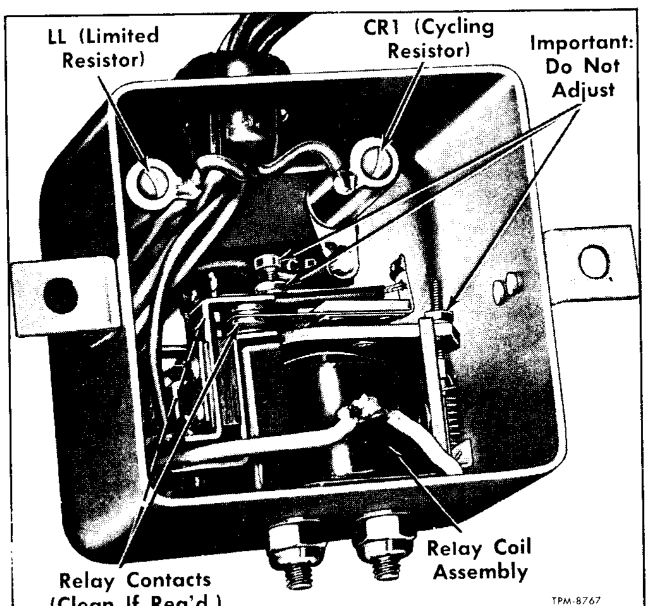


Figure 41—Heating System Control Relay (Special Controls)

NOTE: Resistor identification letters and numbers can be found in relay box on insulator at base of resistors. When thermostat becomes satisfied, circuit through relay operating coil is completed to ground at the thermostat (Junction 12). With relay coil energized, armature is attracted to core, and movable contacts are forced against the stationary contacts. This action breaks the circuit to thermostat heating element, and completes the circuit to the water valve solenoid. Water valve then functions to shut off flow of water through the heater core unit.

TEMPERATURE RANGE CONTROL

Range control, mounted on control panel at left of driver (fig. 27), is marked "TEMP. RANGE" to indicate increasing temperature with clockwise turning. Control will select any temperature in the 10 degree range (68°F. to 78°F.). This device is used with air or electric-operated heating controls. This control is accomplished by increasing or decreasing resistance in the circuit through thermostat heating element as used with electric-operated controls or through an element attached to Grad-U-Stat used with air-operated controls. With dial knob set in lower (68°F.) position, all resistance is taken out of the circuit to the heating element causing thermostat or Grad-U-Stat to cycle at lower temperature. With switch knob turned up, resistance in the rheostat is inserted in the circuit, reducing current flow through the heating element, causing thermostat or Grad-U-Stat to cycle at higher temperatures. Operation of thermostat is explained later under "Thermostat."

Circuit through rheostat is shown on Heating and Air Conditioning Wiring Diagram in back of this manual.

THERMOSTAT

A mercury tube thermostat, mounted in right recirculating air duct (fig. 42), controls the flow of water through heater core unit by energizing or de-energizing the solenoid controlled water valve.

Thermostat controls temperature range in coach from 68°F. to 78°F. as selected by "TEMP. RANGE" on control panel at left of driver.

Two electrical contacts are tapped into thermostat at end of tube. When the mercury column connects the two contacts (thermostat satisfied), circuit through heating control relay coil is completed and water valve solenoid is energized, closing valve.

Two factors control the operation of thermostat, atmospheric temperature in coach acting upon the mercury in bulb, and the thermostat heat element acting upon the mercury column in the therm-

ostat tube. Normally, with thermostat dissatisfied, current is flowing through the heat element around thermostat tube. Amount of current flow is limited by one of the two resistors in the heating control relay and the resistor in the heating control rheostat. Action of heat element tends to complete the circuit between the mercury contacts just before the temperature of the air acting upon the mercury bulb reaches the desired point, shutting off the flow of water through heater core unit. However, heater blower continues to operate, transferring heat in water trapped in heater core unit into the coach interior and continuing to raise coach temperature toward the desired point.

At the same time the circuit is completed to the water valve solenoid, circuit through thermostat heat element is broken, permitting element to cool. This places operation of thermostat entirely under control of the atmospheric temperature acting upon the mercury bulb. If atmospheric temperature is not yet up to the desired point, mercury column will retract rapidly, breaking water valve control circuit and again completing circuit through heat element. If atmospheric temperature is up to the desired point, action of atmospheric temperature upon the mercury bulb will hold the mercury column contact closed, completing circuit. As soon as temperature drops slightly, mercury contacts will break the water valve control circuit, energizing the thermostat heat element and the cycle is repeated.

Action of heat element on thermostat is effective only when the atmospheric temperature is very near the desired level, since it is the atmospheric temperature acting upon the mercury bulb which holds the mercury column high enough in the tube to be affected by the heat element. When the coach temperature is low enough that the mercury column is not affected by the heat element, the water valve remains open until the atmospheric temperature in the coach rises into the cycling zone, which is within 2 degrees of the desired point.

Thermostat electric circuits are shown on Heating and Air Conditioning Wiring Diagram (MD-89320) at back of this manual.

ELECTRIC TYPE WATER VALVE

OPERATION

NOTE: Key numbers in text refer to figure 43.

Water valve shown in figure 43 is in its normally open position. The solenoid is de-energized and the needle valve (5) is open. Water enters valve at right side (right view - fig. 43), and is forced out left side by action of water pump. Weight of water entering valve holds the piston (28) depressed. With needle valve held open by spring (4) no build-up of pressure under the piston can occur,

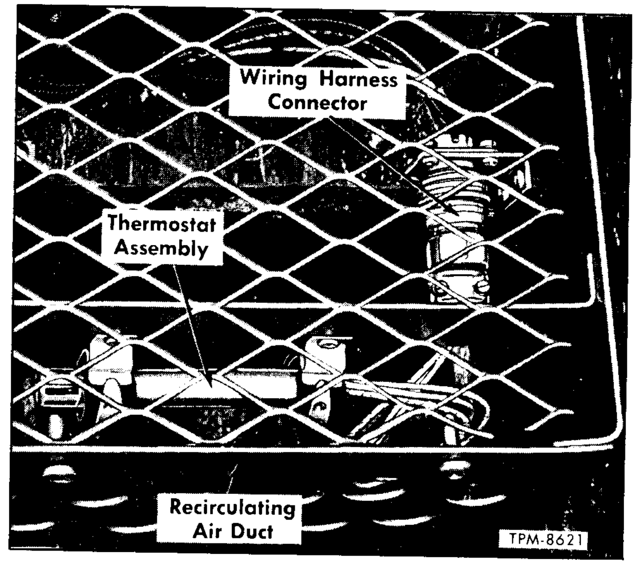


Figure 42—Electric Thermostat Installed (Special Controls)

as it is continuously relieved past the needle valve.

When solenoid (1) is energized by action of the thermostat, the needle valve is attracted to the solenoid core and the needle valve closes. With needle valve closed, water pressure builds up under piston through small restriction port (13) in side of piston and forces the piston upward, with the help of piston spring (20), until the valve disc (8) contacts the valve seat (18). Valve is now in closed position and will remain closed as long as the solenoid is energized, holding the needle valve closed.

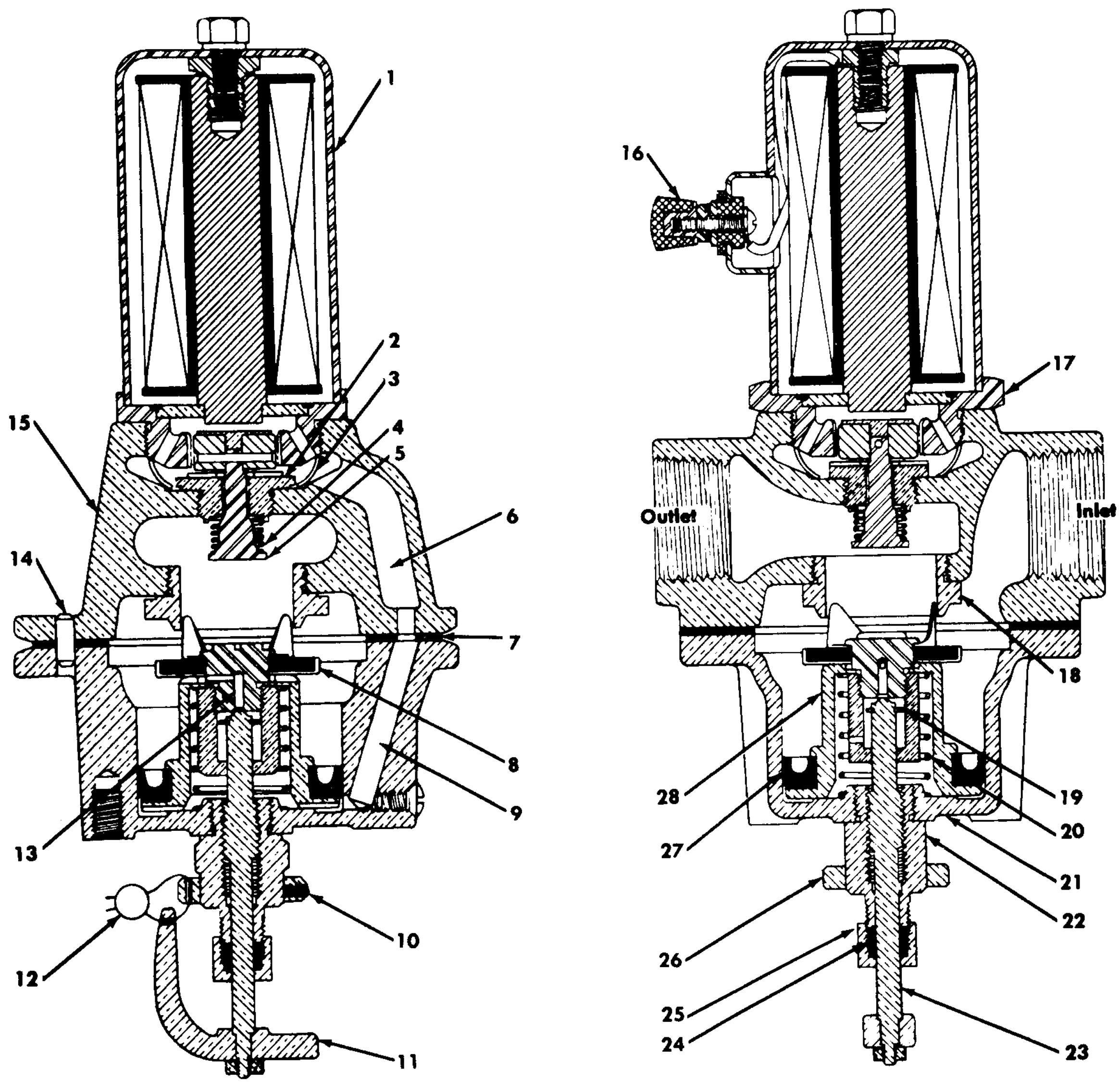
Due to the seal formed between the piston and the bore in the bottom plate by the seal ring (27), piston action is retarded as follows: As the piston rises, a partial vacuum is created under piston, drawing water through a restriction port in side of piston. Since the size of the restriction port restricts fast entry of water, approximately 3 seconds is required for piston to move from open to closed position. Likewise, when valve is opening, the piston can move downward only as rapidly as the water under the piston can be displaced through port in piston. This retarding action is provided to prevent water hammer and shock.

Each valve is designed with a manually operated control stem (23) for the purpose of either holding valve open or for holding valve shut. Stem turned fully clockwise holds valve shut. Stem turned fully counterclockwise retains valve in full-open position. For automatic operation of valve, position stem half way and install seal (12).

REMOVAL

1. Drain heating system as directed previously in this section under "Draining."

HEATING AND VENTILATION



1 Solenoid Assembly
2 Needle Valve Seat
3 Strainer
4 Needle Valve Spring
5 Needle Valve
6 Water Passage
7 Gasket
8 Valve Disc
9 Water Passage
10 Set Screw
11 Handle
12 Seal Assembly
13 Restriction Port
14 Dowel
15 Main Body
16 Terminal Nut
17 Ring Assembly
18 Valve Seat
19 Snap Ring
20 Piston Spring
21 Lower Body
22 Bonnet
23 Manual Control Stem
24 Packing
25 Packing Nut
26 Collar
27 Piston Seal Ring
28 Piston Assembly

TPM-1666

Figure 43—Electric Water Valve (Special Controls)

2. Disconnect heater line hoses from both sides of valve.

3. Disconnect wire from valve solenoid.

4. Remove three cap screws and lock washers attaching valve to mounting bracket, then remove valve assembly.

OVERHAUL

NOTE: Key numbers in text refer to figure 43.

1. If valve assembly fails to operate properly, check the operation of valve solenoid (1) first. Solenoid can be checked by observing through outlet port the closing and opening of valve needle valve (5) when energizing and de-energizing solenoid. If valve is found defective, replace. While solenoid is removed, remove needle valve strainer (3), valve (5), and valve seat (2) from valve main body (15) and examine valve and seat. If either part is worn or damaged, replace with new parts. Clean valve strainer before reinstalling.

2. If solenoid was found working properly, the trouble is in the lower mechanical portion of water valve. Remove eight screws attaching lower body (21) to main body (15) and remove lower body and body gasket (7). Pull piston (28) with stem (23) from body after removing stem handle (11) and turning stem in past bonnet threads. Disassemble valve and stem.

3. Examine valve disc (8) for signs of deterioration or wear. Replace if necessary.

4. Examine valve seat (18) in main body for roughness. Clean or replace seat as necessary.

5. Make sure internal passages (6) and (9) and restriction port (13) in valve body are open. Valve will not function if passages and port are clogged.

6. Inspect piston seal ring (27) on piston and replace if damaged or deteriorated.

7. Make sure inside surface of lower body (21)contacted by seal ring (27) is clean and smooth.

8. When assembling valve, refer to figure 31 for correct position of parts. Make sure passage hole in body gasket (7) is aligned with passage in main body and lower body.

INSTALLATION (Fig. 31)

1. Position valve at mounting bracket and at same time engage heater hoses over fittings at each side of valve. NOTE: "INLET" and "OUTLET" sides of each valve are marked on valve body. Valve must be installed with "OUTLET" toward heater core. Attach valve to mounting bracket with three cap screws and lock washers. Install hose clamps firmly.

2. Connect wire to valve solenoid terminal.

3. Fill heating system as previously directed in this section under "Filling."

4. Start engine and check heater pipe connection for leaks.

UNDERFLOOR HEATING AND COOLING COMPARTMENT

Underfloor heater and cooling compartment is located under coach floor at rear of front axle (fig. 26). Access to compartment being through right forward compartment door and through two wooden inner compartment doors. Right and left inner doors are hinged while center partition is attached to opening with screws and washers.

Compartment is air tight, made so by use of seals at doors and at wiring and lines entering compartment. Water drains and traps in floor under forward area of compartment allows moisture collected on air conditioning evaporator to drain from compartment, and are so designed to eliminate air from entering compartment. Compartment units consists of air pressure regulator valve (with standing heating controls), air filter screen, air conditioning evaporator, heater core and blower unit.

UNDERFLOOR AIR FILTER SCREEN

Air filter screen mounted at forward end of heating and cooling compartment (fig. 26), filters all air passing through compartment and is accessible after opening forward compartment door. Filter is easily removed from compartment by pulling from slide channels.

Clogged filter screen restricts air circulation, thus reducing efficiency of system. In addition to the effect on system operation, dirty filter will permit dirt to pass into the evaporator and heater core clogging coils and fins.

Air filter screen is of all metal construction and should be removed frequently and thoroughly washed. Filter screen should then be sprayed sparingly with odorless oil, or dipped and thoroughly drained.

AIR FILTER SCREEN MUST BE KEPT CLEAN FOR SATISFACTORY OPERATION OF HEATING, COOLING AND VENTILATING SYSTEMS.

Install air filter screen in slide channels with coarse screened surface of filter (if one side is coarser than other) facing front of coach.

HEATER CORE

The heater core located between blower and air conditioning evaporator is of fin and tube design, similar to a conventional radiator. Core can be repaired in same manner as a conventional radiator.

REMOVAL OF HEATER CORE

1. Drain heating system as previously explained under "Maintenance."

2. Disconnect heater supply and return pipe connection hoses at core by removing hose clamps.

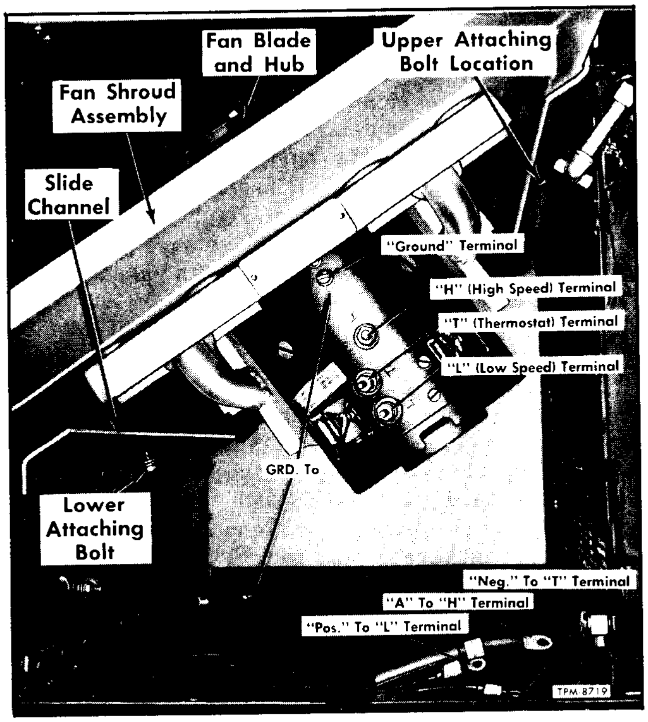


Figure 44—Replacing Blower Assembly

3. Detach water valve and mounting bracket from ceiling of compartment, then carefully move unit forward.

4. Remove center partition from heating and cooling compartment by removing screws and washers.

5. From underneath coach, remove two hex head bolts which attach heater core to compartment floor. Carefully pull heater core from compartment.

INSTALLATION OF HEATER CORE

1. Position heater core in heating compartment. Apply a coating of suitable rust preventive compound to threads of core mounting bolts; then from underneath coach install mounting bolts. Tighten bolts firmly.

2. Connect water supply and return pipe hoses to heater core with hose clamps. Tighten hose clamp screws firmly.

3. Install heating compartment center wooden partition to compartment with screws and washers.

4. Install water modulation valve and mounting bracket to top of compartment.

5. Tighten all hose connections firmly. Refill heating system.

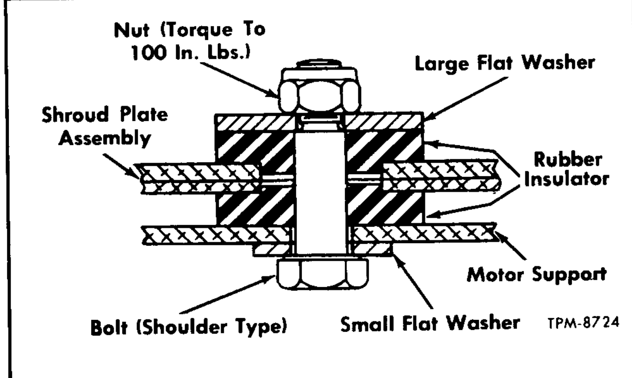


Figure 45—Underfloor Blower Motor Support Mounting

UNDERFLOOR BLOWER AND MOTOR UNIT

Underfloor blower and motor unit consists of the motor, fan blade, and the fan shroud.

Complete assembly is accessible after removing the rear inner closure door within the heating compartment (fig. 26). Door, of wooden construction is retained with screws.

The entire blower unit, supported on two slider channels and secured in position thereon by two bolts, can be readily removed from compartment as explained later under "Underfloor Blower and Motor Unit Replacement."

Blower motor operates whenever the engine is running and when the "VENTILATION" switch at left of driver is in any position other than "OFF." Motor circuit is controlled by a magnetic switch which is mounted on forward bulkhead within heating outer compartment (fig. 26). Servicing of magnetic switch is explained later under "Underfloor Blower Motor Magnetic Switch."

Refer to applicable Heating and Air Conditioning Wiring Diagram in back of manual for all blower motor and switch circuits.

The blower fan blade, attached to shaft end of motor is adjustable fore and aft as well as the motor to provide proper blade to shroud ring alignment. Adjustment and replacement of fan blade is explained later. See "Fan Blade Replacement."

BLOWER MOTOR SPEED CHECK

NOTE: Check should be made when fan blade is installed and unit is located in coach. Run motor to check speed and current draw as follows:

1. With 13-1/2 volts applied to motor, the speed should not be less than 2200 rpm or more than 2400 rpm.

2. Current draw under these conditions should be at least 60 amperes and not more than 75 amperes.

NOTE: No adjustment is provided. If not within specifications, replace.

UNDERFLOOR BLOWER AND MOTOR UNIT REPLACEMENT

(Refer to Figure 44)

REMOVAL

1. Disconnect all wiring at blower motor.
2. Remove bolt at both upper and lower slider channel that retain blower shroud to channel.
3. Grasp outer edge of shroud and pull unit outward.

MOTOR SUPPORT-TO-SHROUD MOUNTING

If necessary, the blower motor support mounting components can be replaced after removing eight special attaching bolts. Figure 45 shows sectional view of each rubber insulated mounting. Refer to illustration when installing components. After installing insulator components, tighten attaching bolt nut to 100 in.-lbs. torque.

INSTALLATION

1. Slide unit into position on coach slider channels.
2. Install shroud upper and lower attaching bolts.
3. Referring to figure 44, connect wiring to respective terminals. Tighten terminal nuts firmly.

FAN BLADE REPLACEMENT

REMOVAL

1. Remove entire blower motor, fan and shroud unit from coach as instructed previously under "Underfloor Blower and Motor Unit Replacement."

2. Referring to figure 46, remove three cap screws which attach tapered fan blade hub to blade. Using two of these same screws as puller screws in tapered holes of hub, separate hub evenly from blade.

3. Pull hub and blade from motor shaft. Remove hub key.

INSTALLATION

NOTE: Before installing fan blade, check four motor-to-support bolts which should be tight.

1. Locate key in groove of motor shaft.
2. With fan blade located over tapered hub and with attaching cap screw holes aligned, install hub and blade on motor shaft.
3. Align blade and hub on shaft so that when the three attaching cap screws are tightened to 80 to 85 in.-lbs. torque, the rear tip edge of blade will be 0 to 3/16" from shroud ring as shown in figure 46.
4. If sufficient adjustment cannot be obtained, the motor can be repositioned in motor support by use of slotted attaching bolt holes (fig. 47). Tighten bolts firmly after making adjustment.

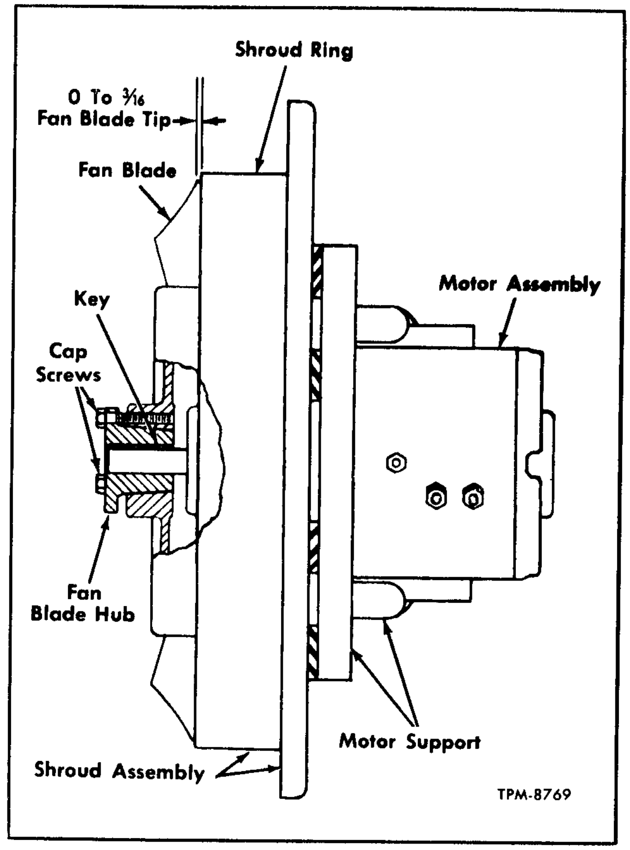


Figure 46—Underfloor Blower Fan Blade Installation

UNDERFLOOR BLOWER MOTOR AND REPAIR

DESCRIPTION

The blower motor assembly (fig. 48) is a two-speed DC sealed ball bearing motor incorporating internal thermal protection, and operates as a series motor for high-speed (air-conditioning and "BLOWER" - "HI") operation and as a compounded motor for low-speed (heating and "BLOWER" - "LO") operation. The vehicle wiring is so arranged, that blower magnetic switch is grounded through the built-in circuit breaker which in the event of motor overheating, will de-energize the armature and series circuit until operating temperature lowers to a point where the circuit breaker will close and again allow normal operation.

It should be noted that the thermostat ("T") terminal should not be used for a ground other than for the designed load, in this case the magnetic switch energizing coil. Motor is grounded through the 1/4-20 ground screw in the motor frame adjacent to the "H" terminal.

Drive end frame of motor differ on early and late motors. Figure 48 shows end frame construction views.

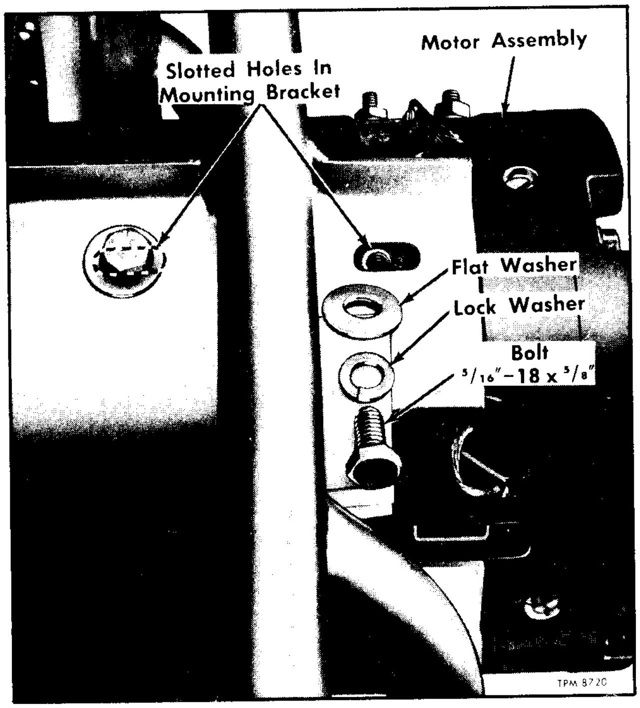


Figure 47—Underfloor Blower Motor Mounting

REMOVAL OF BLOWER MOTOR

1. Remove blower assembly as directed previously under "Underfloor Blower and Motor Unit - Replacement."
2. Remove fan blade from motor shaft as directed previously under "Fan Blade Replacement."
3. Remove four bolts which attach motor to motor support (fig. 47).
4. Carefully remove motor assembly from support.

COMMUTATOR AND BRUSHES

Motor commutator can be cleaned and brushes replaced without disassembling motor.

1. If commutator is dirty, clean with strip of No. 00 sandpaper. Do Not Use Emery Cloth. All dirt must be blown from motor after cleaning.
2. Brushes should be replaced if they measure less than 7/8 inch on the long side. If brushes are of sufficient length but are not seating on commutator properly, seat brushes, using a "bedding" stone. Do Not Use Emery Cloth or Sandpaper. With motor operating, press bedding stone firmly against area on commutator contacted by brushes. Brushes should seat satisfactorily in a short period. Blow motor out with compressed air to remove all particles of abrasive after using stone, then check tightness of pigtail lead connections.

If, after the foregoing inspection operations, motor still fails to run, it will be necessary to disassemble motor to accomplish needed repairs.

3. To replace brushes, refer to figure 49, which shows operational brush replacement views.

a. To remove individual brush, push down on spring and back assembly, then forward toward brush to disengage back from retaining lugs. See left view of figure 49. Release back, then remove brush from back assembly.

b. Remove screw which secure brush cable to bracket. Remove brush. Center view of figure 49 shows brush separated from spring and back assembly.

c. Install new brush in back and spring assembly, then force assembly downward beyond installed position, then move back assembly rearward and release it to engage positioning or retaining lugs as shown in right view of figure 49.

d. Attach brush cable to bracket with screw.

DISASSEMBLY OF MOTOR

NOTE: Figure 48 shows sectional view of motor assembly.

1. Remove thru-bolts which attach endframes to motor housing.
2. Tap end frames with soft hammer to loosen, then separate end frames.
3. Remove armature from motor housing and winding assembly.
4. If necessary, shaft bearings can be readily removed from shaft or end frames using a conventional bearing puller.

PARTS INSPECTION AND TEST

Before proceeding with repair operations, the following inspections should be made:

1. Check armature to commutator leads to be sure they are properly soldered. Loose leads should be resoldered.
2. Inspect commutator and if found to be rough, out-of-round, worn, has high mica, or is badly burned, replace armature or repair commutator as instructed later under "Armature Repair."
3. Inspect field coil insulation. If insulation is cracked, charred, or worn so that wire is exposed, it is recommended that field coil and frame assembly be replaced.
5. Check length of brushes and replace if less than 7/8 inches long, measured on longest side. Be sure that pigtail leads are secure in the brushes and that terminals are properly fastened to leads.
6. Carefully inspect ball bearing assemblies for evidence of damage or wear. If rough, pitted, or worn; replace bearing assembly.
7. Inspect brush bracket assembly and brush retainer spring assembly for wear or damage. If either assembly is badly worn or broken, replace with new assembly.

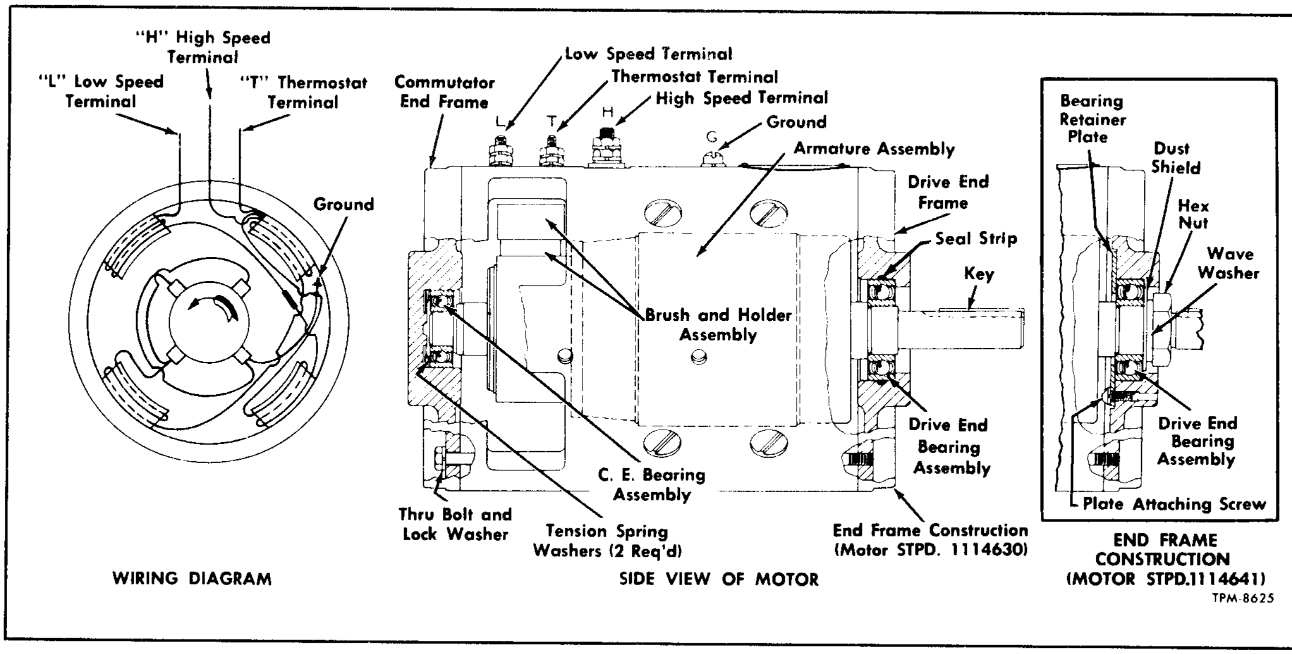


Figure 48—Underfloor Blower Motor

TESTING ARMATURE

1. With a conventional test light and prods, test armature for ground. Place one test prod on armature and other on commutator. If test light lights, armature is grounded and should be replaced.

2. If armature is open circuited, this can easily be detected visually, since an open circuit in the armature usually results in badly burned commutator bars.

3. To test armature for short circuit, place armature on growler connected to alternating current. Hold hack saw blade over armature while armature is rotated slowly. If saw blade vibrates or buzzes, armature is short circuited and should be replaced. However, before replacing an armature that is apparently shorted, inspect commutator slots for copper or brush dust deposits, clean thoroughly, and re-test.

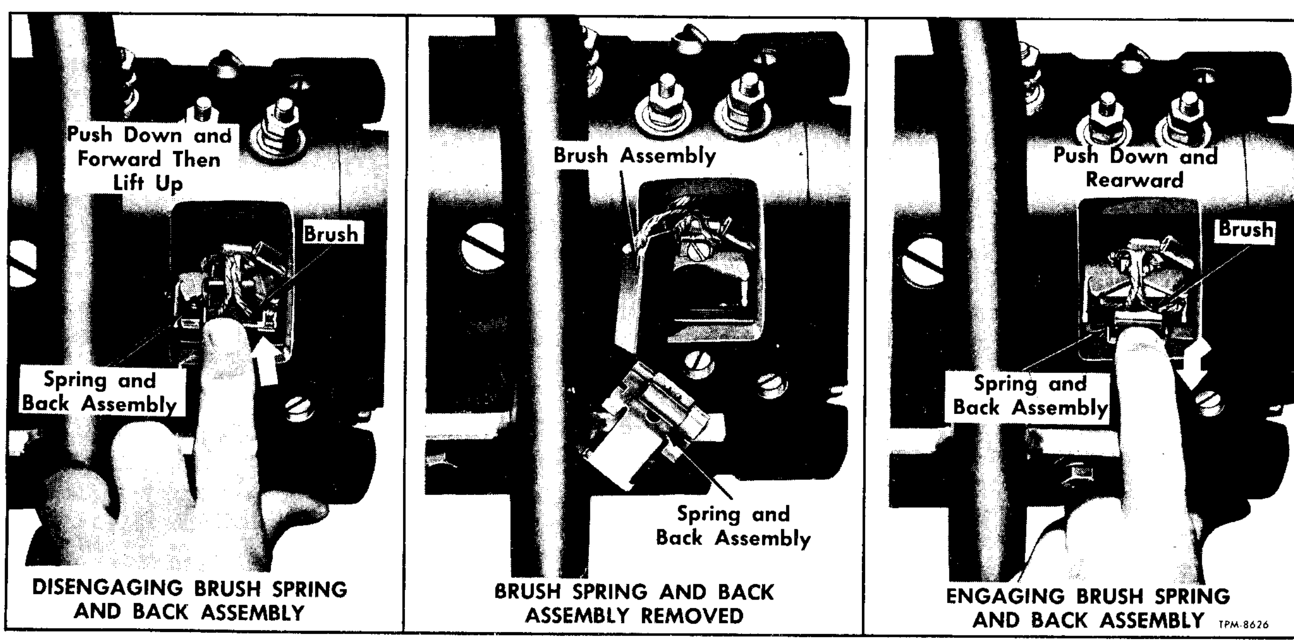


Figure 49—Replacing Underfloor Blower Motor Brushes

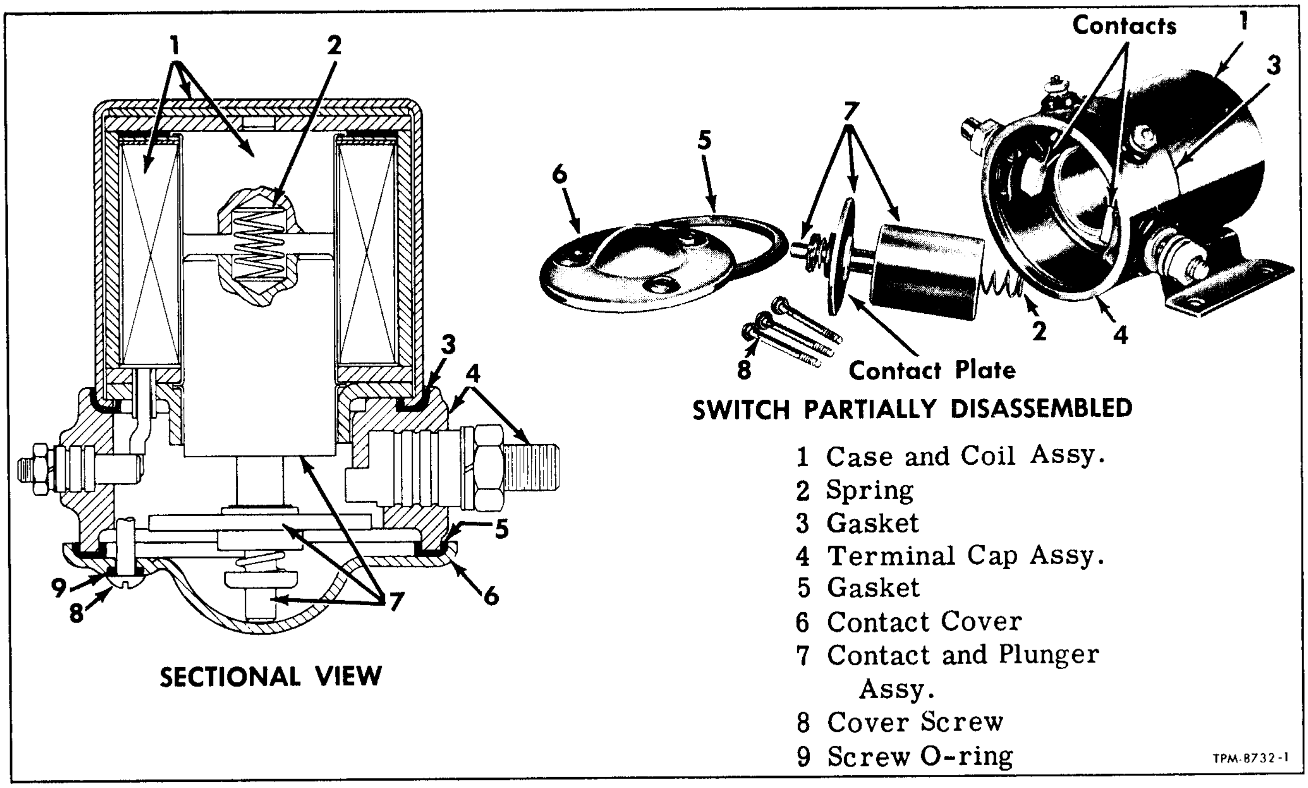


Figure 50—Underfloor Blower Motor Magnetic Switch

4. Test armature terminal circuits for continuity. Place one test prod on armature terminal and other on terminal of each wire. If test lamp fails to light, wire is open circuited and should be replaced.

ARMATURE REPAIR

1. To turn down commutator, center armature in lathe; then machine until rough or worn spots or out-of-round condition has been removed.

CAUTION: Do not machine more than necessary. Commutator must not be turned down to less than 2.9375" in diameter.

2. Mica between commutator segments must be below surface of segments. If this condition does not exist, undercut mica until it is 1/32" below surface of segments. After undercutting, use No. 00 sandpaper to clean and smooth up commutator, then use compressed air to remove all fine particles of cuttings.

3. If armature is open-circuited, burned commutator riser bars may result. When bars are not too badly burned, armature can sometimes be saved by rewelding the leads in the riser bars. After welding, turn down commutator and undercut mica as directed in steps 1 and 2.

ASSEMBLY OF MOTOR

After all parts have been inspected and repaired or replaced, blower motor may be assembled as follows:

1. Install new bearing assembly in commutator end frame.

NOTE: When installing commutator end frame bearing on motor stamped 1114630, make sure two tension spring washers are installed between bearing and frame recess. Only one washer is used on late type motor stamped 1114641.

2. Install bearing in drive end frame. NOTE: On early type motor stamped 1114630, insert pliable seal strip into recessed groove of end frame before inserting bearing. Coat seal lightly with clean lubricant. Bearing assembly on late type motor stamped 1114641, is retained in end frame by a plate which is secured with screws. (See applicable view, fig. 48.)

3. Position armature, case, and end frames together, then install retaining thru-bolts.

NOTE: On late type motor stamped 1114641, install dust shield, wave washer, and hex nut on motor shaft as shown in figure 48. Tighten nut firmly.

4. Connect all leads and install brushes.

IMPORTANT: Motor speed check must be made when fan blade and motor is installed. Refer to "Blower Motor Speed Check" previously.

INSTALLATION OF BLOWER MOTOR

1. Place motor on motor support.
2. Align motor mounting tapered holes with slotted holes in support. Install four bolts (5/16"-18 x 5/8") with washers as shown in figure 47. Tighten bolts firmly, even though they may have to be loosened later when fan blade is installed or aligned later.

UNDERFLOOR BLOWER CONTROL MAGNETIC SWITCH

Blower control magnetic switch (fig. 50), which controls blower motor circuit is mounted on forward bulkhead in outer compartment of the underfloor heating compartment (fig. 26). Electrical circuits and connections are shown on applicable Heating and Air Conditioning Wiring Diagram. Relay controls only the blower high speed circuit; low speed circuit is routed directly from the "VENTILATION" switch to the blower motor.

Circuit is hot to magnetic switch only when the generator is charging. Relay operating coil is connected to No. 1 terminal on "VENTILATION" switch. Operating coil is energized whenever switch is in "BLOWER" - "HI" or "AIR CONDITION" position. With operating coil energized, relay contacts close, completing circuit from ventilation compartment battery junction to high speed circuit of blower motor.

The relay winding assembly is not removable from the case, however, the contact disc, plunger, and plunger return spring can be removed and replaced after removal of the cover. Gaskets on both sides of the molded terminal ring seal the contact compartment. Figure 50, shows sectional and exploded views of magnetic switch. If necessary, contacts surfaces both within the terminal cap and on the contact and plunger assembly can be cleaned using fine grade sandpaper. When assembling, make sure gaskets are in good condition and properly seated.

DEFROSTER HEATER

Defroster heater unit, consisting of a heater core and two motors with individual blowers is installed in dash compartment, front of dash center closure panel (fig. 51). Air is distributed by blowers to six defroster air outlets through four flexible air ducts. Air can also be deflected toward driver's feet through damper controlled outlet. Outlet damper is manually controlled.

Slotted head bleeder plug is located at left-upper corner of heater core. Flow of water through heater core is controlled by temperature control valve installed in heater core supply line.

Control valve knob is mounted on side of heater compartment at right of driver.

Air drawn through heater core may be all recirculated air, taken in through dash compartment opening, or part outside air taken in through heater ventilator intake. Heater ventilator intake may be opened or closed by driver, by operating damper control lever, located under dash panel at left of heater.

Defroster heater blowers and motors are mounted at underside of heater. Motors require no maintenance, and should operate indefinitely without attention. In the event of failure, motors can be disassembled, brushes replaced, and commutators turned and undercut in accordance with established practice. Whenever motor is disassembled, bearings should be lubricated at assembly. Defroster blowers are controlled by a two-speed "DEFROST" - "HI" and "LO" switch located on control panel at left of driver. Defroster motor circuit is protected by No. 11 circuit breaker on circuit breaker panel, which is located at left of driver. Circuits to defroster blower motors are equipped with a relay mounted at underside of heater (fig. 51). Refer to "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7) for information on relay.

Heater core, blowers, blower motors, motor relay, temperature control valve, water pipe connections and water drain cocks are accessible after removing dash center closure panel which is attached to front end with screws.

Heater core can be removed from unit after draining system, removing heater unit panel, and disconnecting core hoses.

VENTILATION

Outside air is admitted to coach interior, through various window openings and through a screened intake in front panel located in front of defroster heater. Amount of outside air entering heater is manually controlled by operator. Pushing of damper lever located at right of operator under dash ledge, forward will open air intake and pulling rearward on lever will close intake.

Refer to "DEFROSTER HEATER" described previously for operation of blowers and motors which are used in conjunction with ventilation at front of coach.

Outside air is also drawn into interior of coach by the underfloor blower, through two perforated

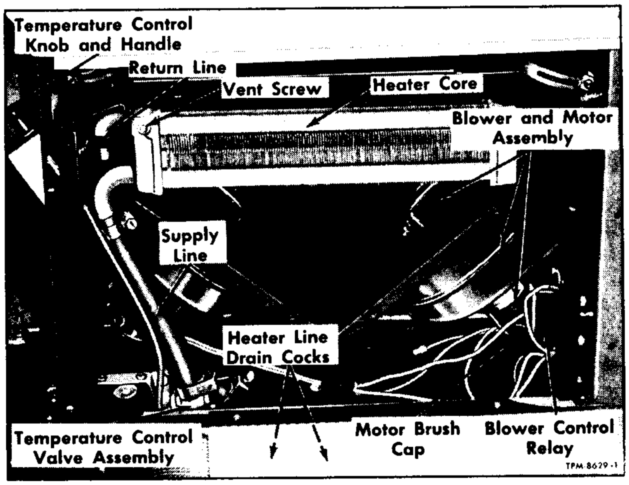


Figure 51—Defroster Heater Assembly Installed

openings - one each side of body below forward side windows. Air is then forced into ducts and distributed throughout coach.

If ventilation is desired without cooling system in operation, place "VENTILATION" switch on control panel at left of driver in "BLOWER - HI" position. All air intakes should be adjusted for maximum passenger comfort.

NOTE

At regular coach inspection intervals, check operation of all heating and ventilation controls. Properly adjusted controls will assure maximum comfort for passengers and driver.

SPECIFICATIONS

UNDERFLOOR BLOWER MOTOR
- Make .... Delco-Remy
- Model (Early) 1114630
- (Late) 1114641
- Rotation (Shaft end) .... CW
- Blower Speed (High) 2300
- (Low) 1750
- Horsepower 8/10
- Volts 12

WATER BOOSTER PUMP MOTOR
- Make .... Marine Products Co.
- Model 2900
- Volts 13.5
- Amperes 9.5
- Rotation (Commutator End) .... CW
- RPM 3000
- GM Part Number 2397746
- H.P. .... ⅛

WATER VALVE
(Standard Air-Operated)
- Make .... Minneapolis-Honeywell
- Type VP511A1016
- GM Part Number 2389439

(Special Electric-Operated)
- Make .... Vapor Heating Corp.
- Model Number 3545-3715
- Volts 12
- Valve Position .... Normally Open

UNDERFLOOR BLOWER MOTOR MAGNETIC SWITCH
- Make .... Delco-Remy
- Stamped 1119841
- Volts 12
- Amperes .... 1.05—1.17

HEATING SYSTEM CONTROL RELAY (Special)
- Make .... Vapor Heating Corp.
- Stamped 36030011
- GM Part Number 2421298

AIR PRESSURE REGULATOR VALVE (Standard)
- Make .... Minneapolis-Honeywell
- GM Part Number 2357613
- Type 73-26
- Setting .... 17 psi

GRAD-U-STAT (Standard)
- Make .... Minneapolis-Honeywell
- GM Part Number (Std.—less heating element) 2340294
- Type TP-900F1032
- GM Part Number (Special—with heating element) 2383252
- Type TP-900F1040

THERMOSTAT (Special)
- Make .... Vapor Heating Corp.
- GM Part Number 2407847
- Stamped 35633150
- Type .... Mercury
- Volts 12
- Temperature Setting .... 78°F.
- Number of Socket Terminals 3

FRONT DEFROSTER HEATER MOTORS
- Number Used 2
- Make .... Kysor Heater Co.
- Kysor Number C-11027-2
- GM Part Number 2379322
- Model 52-018
- Type .... Series
- Rotation (Shaft End) .... Counterclockwise
- Volts 14
- RPM 2600
- Amperes 5.0

UNDERSEAT BLOWER MOTOR
- Make .... Universal Electric
- Model 4-107
- GM Part Number 2361146
- Type .... Series Wound
- Volts 12
- Amperes 3
- Rotation (Shaft End) .... Clockwise
- RPM 3000

STANDARD HEATING SYSTEM TROUBLE SHOOTING GUIDE

TROUBLE	POSSIBLE CAUSES
UNDER-HEATING (Items with an asterisk (*) also apply to under-cooling)	Grad-U-Stat setting too low *Grad-U-Stat out of calibration *Grad-U-Stat valve unit sticking or damaged *Water modulating valve stem bent or sticking *Foreign material in water modulating valve body *Blower inoperative *Air filter dirty Heater core dirty *Proportion of outside air admitted too high *Clogged recirculated air inlet screen Heater line gate valves closed Air in heater system water lines Excessive heat at defroster heater UNDER-COOLING ONLY: Grad-U-Stat setting too high. Pressure regulator valve setting too low. Leakage in air lines and fittings.
OVER-HEATING (Items with an asterisk (*) also apply to over-cooling)	Grad-U-Stat setting too high *Grad-U-Stat out of calibration *Grad-U-Stat valve unit sticking or damaged Pressure regulator valve setting too low Leakage in air lines and fittings Defective diaphragm in water modulation valve Outside air intake restricted OVER-COOLING: Grad-U-Stat setting too low.
ALTERNATE UNDER- AND OVER-HEATING	Water modulating valve stem bent or sticking Throttling range setting of Grad-U-Stat too low (Also applies to alternate over- and under-cooling)
NOTE: Throttling range setting of $6^{o}F$. is recommended for Grad-U-Stat.	

SPECIAL HEATING SYSTEM TROUBLE SHOOTING GUIDE

TROUBLE	POSSIBLE CAUSES
UNDER-HEATING (Items with an asterisk (*) also apply to under-cooling)	Defective underfloor blower motor Heater line gate valves closed or partly closed *Water valve needle valve sticking *Heating system control relay defective Air filter screen dirty *Defective thermostat Water booster pump inoperative *Defective rheostat *Air in heater units or lines *Clogged recirculated air inlet screen *Excessive heat at defroster heater UNDER-COOLING ONLY: Rheostat defective or set too high.

HEATING AND VENTILATION

SPECIAL HEATING SYSTEM TROUBLE SHOOTING GUIDE (CONT'D)

TROUBLE	POSSIBLE CAUSES
OVER-HEATING (Items with an asterisk (*) also apply to over-cooling)	Water valve diaphragm ruptured Loose wiring connections Insufficient pressure in heating system lines and units *Defective rheostat *Heating system control relay defective Outside air intakes restricted Water valve solenoid defective *Defective water valve (mechanical portion) *Defective thermostat (fails to complete circuit)
ALTERNATE UNDER- AND OVER-HEATING	Loose wiring connection Water valve defective System control relay defective Defective thermostat

TROUBLE SHOOTING PROCEDURE (SPECIAL HEATING CONTROLS)

COACH IS NOT HEATING PROPERLY:

1. Disconnect the wire on the water valve terminal. Since the water valve is normally open, this should permit a full flow of hot water to the heating system.
2. If, with water valve wire disconnected, coach system still fails to heat, check position of the water valve manual valve to see if the wire seal has been broken. If the seal is broken, turn the handle clockwise until the valve is fully closed. Back off the handle five full turns (counterclockwise) to place it in the correct automatic position. Hot water should flow through the valve.
3. If it does not, remove the water valve for bench servicing.
4. If water flows with valve wire disconnected, but does not flow when it is connected to the control system, disconnect the thermostat leads. This should de-energize the relay coil and cut off any chance of current feeding to the normally open water valve and closing it.
5. If the water valve still remains closed, check the wiring to and from the control relay; make sure that resistors in relay box are threaded in tight. Check relay separately by passing current through the yellow and grounding orange leads. This energizes the relay coil and contacts should close the water valve. Remove the orange lead from ground and the valve should open.

   NOTE: It is almost impossible to have the coil remain energized as the result of thermostat or relay failure. The trouble would most likely be caused by water valve failure or incorrect wiring of the system.

   NOTE: Do not attempt repair of the thermostat. Replace if necessary.

COACH OVERHEATS OR HEATS CONTINUOUSLY (NO CONTROL):

1. Disconnect the thermostat leads and touch orange wire to ground. This should energize the relay coil and close the water valve. If the valve closes, failure is in the thermostat or the thermostat is not connected properly into the circuit. Check the wiring diagram MD-89320. Be sure to check manual shut-off handle on water valve as described above.
2. If the control relay does not energize when orange wire is grounded, check for open circuit or replace.
3. If the relay is supplying current to the water valve when the orange wire is grounded, the water valve should close. If it does not close, it should be removed for servicing.

Lavatory

DESCRIPTION

Lavatory and toilet facilities are provided for passenger comfort and convenience (fig. 52) as special equipment. Lavatory is located at right rear corner of coach. Lavatory compartment is equipped with wash basin, chemical toilet, liquid soap dispenser, mirror, waste paper container, toilet tissue dispenser, paper towel dispenser, ash tray, and on some coaches a sanitary napkin dispenser. Figure 53 illustrates schematic layout of lavatory plumbing.

Window in lavatory is frosted, thus assuring maximum privacy. An electric motor driven blower shown in figure 54 is used to exhaust objectionable odors from lavatory compartment. Another electric motor driven water pump, located on floor in front of lavatory transverse partition (fig. 55), supplies water to wash basin from a 10 gallon water tank also located front of lavatory compartment. A permanently installed 12 gallon chemical waste tank is located directly below lavatory compartment. Tank has facilities for emptying beneath the coach, thus eliminating the possibility of odors entering coach.

OPERATION

Whenever possible, automatic controls are provided for maximum passenger safety, comfort and privacy. Following information describes purpose and function of individual units.

VENTILATOR BLOWER

Ventilator blower, mounted in toilet rear ledge compartment as shown in figure 54, forces objectionable odors from the lavatory compartment to the engine air intake.

Blower operates whenever the engine is running or whenever the lavatory is occupied with the door locked from the inside. Motor is energized through a relay located in the electrical apparatus compartment at right rear side of coach. See item 16 on figure 6 in ELECTRICAL (SEC. 7).

A 6-amp line fuse is installed in blower motor feed wire near the blower motor (fig. 54). Refer to "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7) for description of lavatory control relay and the blower relay. All relay circuits are shown on "Lavatory Wiring Diagram - MD-89108" in back of this manual.

BLOWER RELAY

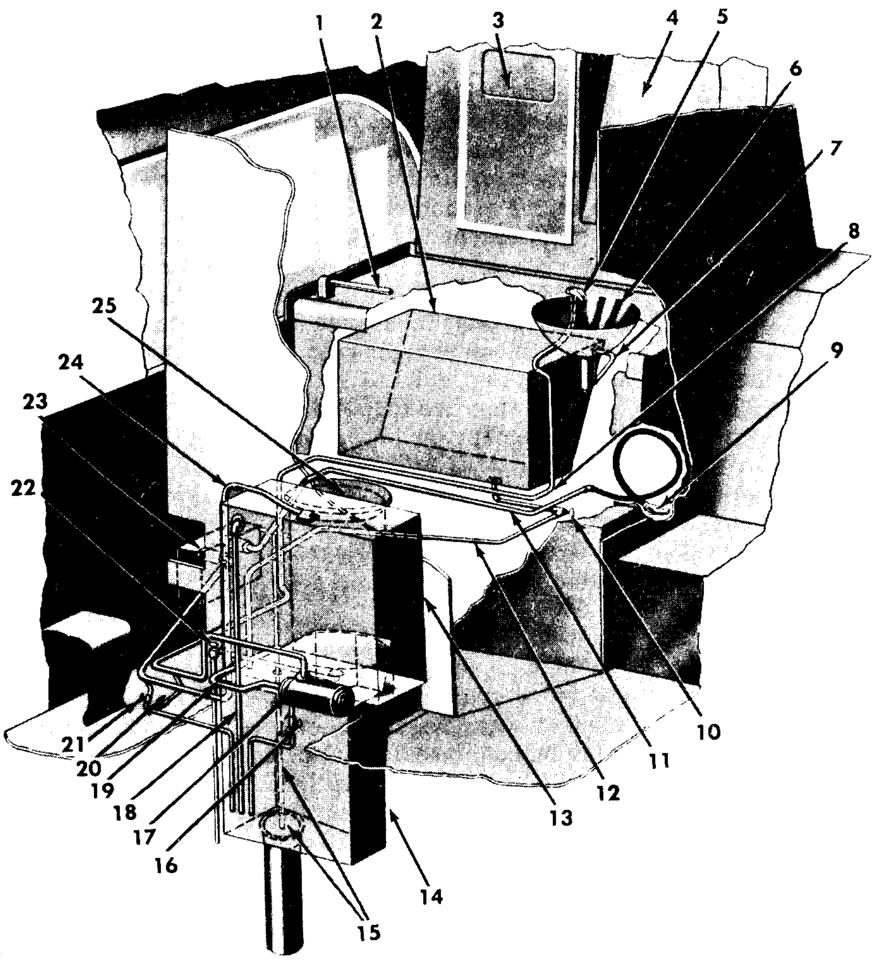
Blower relay controls lavatory blower motor and is located in the electrical apparatus compartment at right rear side of coach. Circuit through relay is explained under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7). Refer to "Lavatory Wiring Diagram - MD-89108."

1 Waste Paper Container
2 Mirror
3 Water Pump Switch
4 Soap Dispenser
5 Basin Spout
6 Wash Basin
7 Towel Dispenser
8 Sanitary Napkin Dispenser Location (When Equipped)
9 Toilet Tissue Dispenser
10 Compartment Door
11 Compartment Door Inside Lock
12 Emergency Switch (To Signal Driver)
13 Lavatory Stool
14 Service Compartment Access Door
15 Hand Rail

TPM-8615

Figure 52—General Arrangement of Lavatory

LAVATORY



1 Grab Handle
2 Wash Basin Drain Tank
3 Wash Paper Container
4 Mirror
5 Basin Spout
6 Wash Basin
7 Basin-to-Drain Tank Line
8 Pump-to-Basin Line
9 Toilet Stool Flushing Hose
10 Wash Basin Drain Tank Drain Valve
11 Flushing Hose Supply Line
12 Basin-to-Chemical Tank Drain Line
13 Basin Water Supply Tank
14 Chemical Tank
15 Chemical Tank Drain Plug and Handle
16 Water Pump Housing Drain Cock
17 Water Pump and Motor Assy.
18 Water Supply Tank Overflow Line
19 Water Supply Tank-to-Water Pump Line
20 Water Supply Tank-to-Basin Supply Line Drain Cock
21 Water Supply Tank Service Line Drain Cock
22 Water Supply Tank Drain Valve
23 Lavatory Water Service Fittings
24 Water Supply Tank Service Line
25 Toilet Stool

TPM-8614

Figure 53—Schematic of Lavatory Water Lines and Units

LAVATORY CONTROL RELAY

Lavatory control relay which controls circuit to lavatory lights and units is located in electrical apparatus compartment at right rear side of coach. See item 17 in figure 6 in ELECTRICAL (SEC. 7). Circuit through relay is explained under "Relays" in electrical section. Refer to "Lavatory Wiring Diagram - MD-89108" in back of this manual for relay circuit.

WASH BASIN SUPPLY PUMP

Electrically operated water pump shown in figure 55 located at rear of last seat on right side of coach, supplies water to the wash basin when required. Pump operates when water pump switch button shown in figure 52 is pressed in. A check valve mounted in basin supply line above water pump retains water in line when water pump is not operating. Electrical circuit to water pump motor is explained later under "Basin Water Pump Switch" and "Basin Water Pump Limit Switch."

BASIN WATER PUMP SWITCH

Water pump switch marked "PUSH FOR WATER" is located in the lavatory compartment as shown in figure 52. By pressing switch button, circuit is completed to water pump limit switch and to water pump motor. For circuit continuity, refer to "Lavatory Wiring Diagram - MD-89108" in back of this manual.

BASIN WATER PUMP TIME LIMIT SWITCH

Water pump time limit switch is mounted in electrical apparatus compartment as shown in figure 6 in ELECTRICAL (SEC. 7). See item 15. Limit switch is connected in series with water pump

motor circuit. When water pump switch button is pressed in, water will flow into wash basin for approximately 15 seconds, then limit switch will break pump circuit and water will cease to flow. After waiting approximately 18 seconds, limit switch element will cool and contacts within switch will close, and again complete circuit to pump motor. For circuit continuity, refer to "Lavatory Wiring Diagram - MD-89108."

LAVATORY EMERGENCY BUZZER

Lavatory emergency buzzer is mounted on panel under dash in front of driver as shown in figure 56. Buzzer is operated by push-button type switch marked "TO SIGNAL DRIVER - EMERGENCY ONLY" is located on transverse partition of lavatory compartment (fig. 52). To check circuit continuity, refer to "Lavatory Wiring Diagram - MD-89108" in back of this manual. If buzzer becomes defective, it must be replaced.

EMERGENCY BUZZER SWITCH

Emergency buzzer switch marked "TO SIGNAL DRIVER - EMERGENCY ONLY" is located on transverse partition of lavatory compartment as shown in figure 52.

DOME LIGHTS

Two dome lights are mounted in ceiling of lavatory. Forward light is connected in coach marker light circuit and is illuminated whenever marker lights are turned on. Lamp mounted in ceiling over mirror is illuminated only when lavatory is occupied and door is closed and locked. For circuit continuity, refer to "Lavatory Wiring Diagram - MD-89108" at back of this manual.

LAVATORY SIGN LIGHT

Lavatory sign light located on transverse partition of compartment is illuminated when lavatory is occupied, door closed, and locked. Sign reads "WASH ROOM - OCCUPIED."

LAVATORY DOOR LOCK

Door lock, installed on lavatory door, has inside and outside latch handles to open and close door as shown in figure 57. Lift up on latch when entering lavatory. In addition, inside of lock is fitted with a locking lever, which forces latch bolt outward to operate a switch in transverse partition. If locking lever fails to release, door can be opened from outside by a special key furnished to driver.

Lock assembly can be removed from door, then readily disassembled and parts replaced if necessary. Figure 58 shows backing plate removed, exposing all internal parts. A light application of Lubriplate to all moving parts will assure free operation.

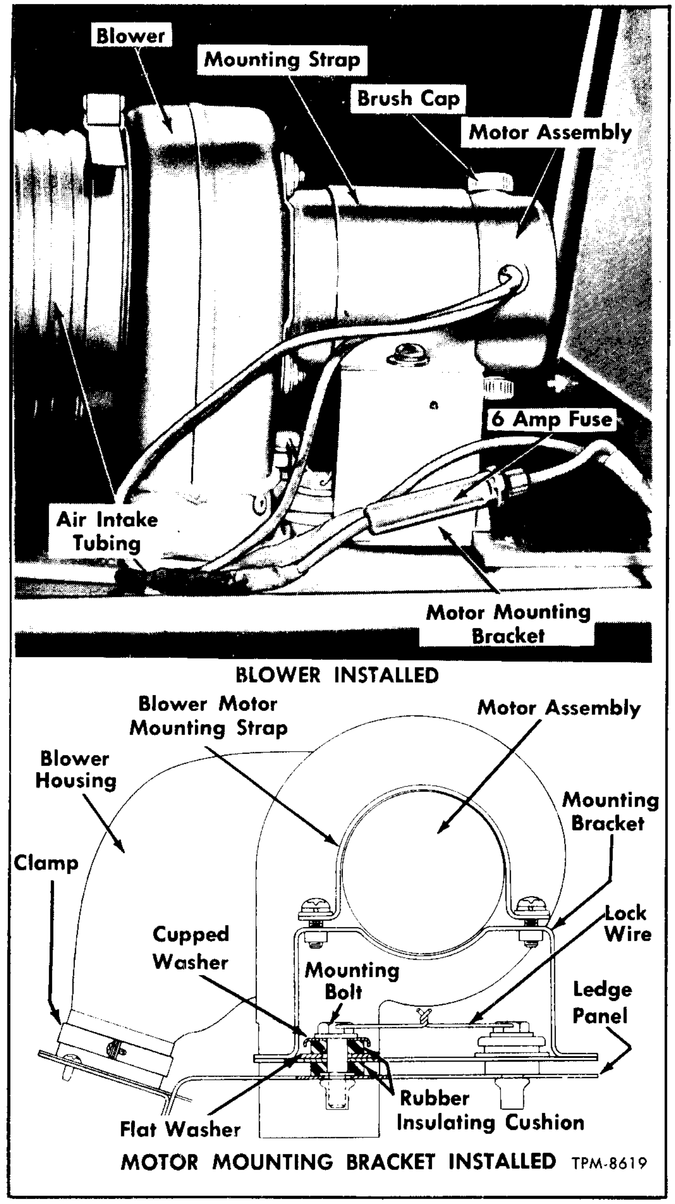


Figure 54—Lavatory Ventilation Blower and Motor Installed

DOOR LOCK SWITCH

Door lock switch is "Micro" type and is installed in edge of transverse partition as shown in figure 57. Switch is closed by outward movement of door lock bolt when door is locked from inside compartment. Closing of lock switch completes electrical circuit to lavatory 21 C.P. light, washroom occupied sign light, and it also energizes blower relay to operate ventilation blower motor. For circuit continuity, refer to "Lavatory Wiring Diagram - MD-89108" in back of this manual.

Switch is adjustable to lock bolt as explained later under "Maintenance."

LAVATORY

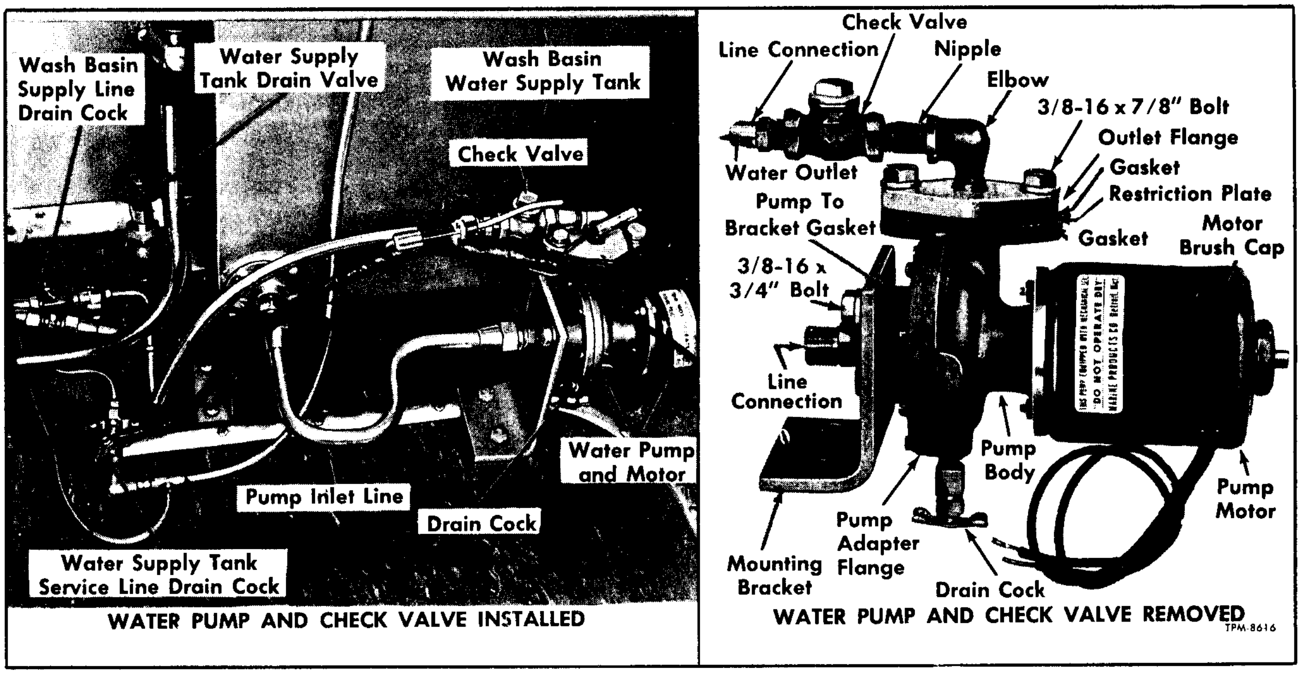


Figure 55—Wash Basin Water Pump and Check Valve Installed

MAINTENANCE

GENERAL

Lavatory filling, and flushing service line fittings are accessible after opening access door at right rear side of coach (fig. 59). Ends of lines are equipped with quick release coupling fittings to which a flexible service hose with a mating coupling (fig. 60) can be attached for servicing tanks.

Hose coupling, which is of the Hansen 6000 Series, can be obtained at your local Hansen dealer or can be ordered from the Hansen Mfg. Co., 4031 West 150th St., Cleveland, Ohio.

Coupling hose can usually be purchased locally or can be ordered from the Gates Rubber Co., Denver, Colorado.

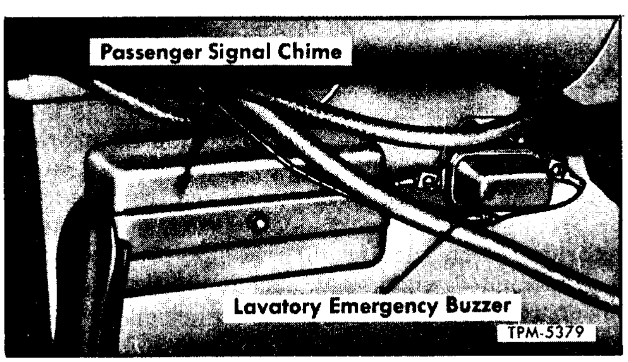


Figure 56—Lavatory Emergency Buzzer and Passenger Signal Chime Installed

Two valves are used when servicing lavatory; the wash basin drain line to chemical tank valve (10, fig. 53) and the water supply tank drain line valve (22, fig. 53).

For the purpose of draining the chemical tank, special connectors and fittings shown in figures 61 and 62, are available from the Service Department, General Motors Truck and Coach, Pontiac, Michigan.

NOTE: Instructions for draining the entire system are explained later. See "Draining of Entire Lavatory System."

WASH BASIN SUPPLY TANK

Wash basin supply tank is constructed with line fittings extending within tank as shown in figure 63. Location of these internal fittings determine the water level in tank at which the tank will overflow and the level at the outlet to the water pump when tank is empty.

Tank is equipped with an air breather assembly and a one-way check valve assembly as shown in figure 64. Upon the filling of tank, air and overflow water is exhausted out the overflow line and out through a rubber trap at bottom of line underneath coach. This rubber trap, acts as a one-way check valve, allowing the exhaust of air and water. When water is being drawn out of tank by water pump or by the opening of tank drain valve, air is admitted into tank to displace outgoing water not through the rubber trap but through the air breather and the one-way check valve at top of tank. Period-

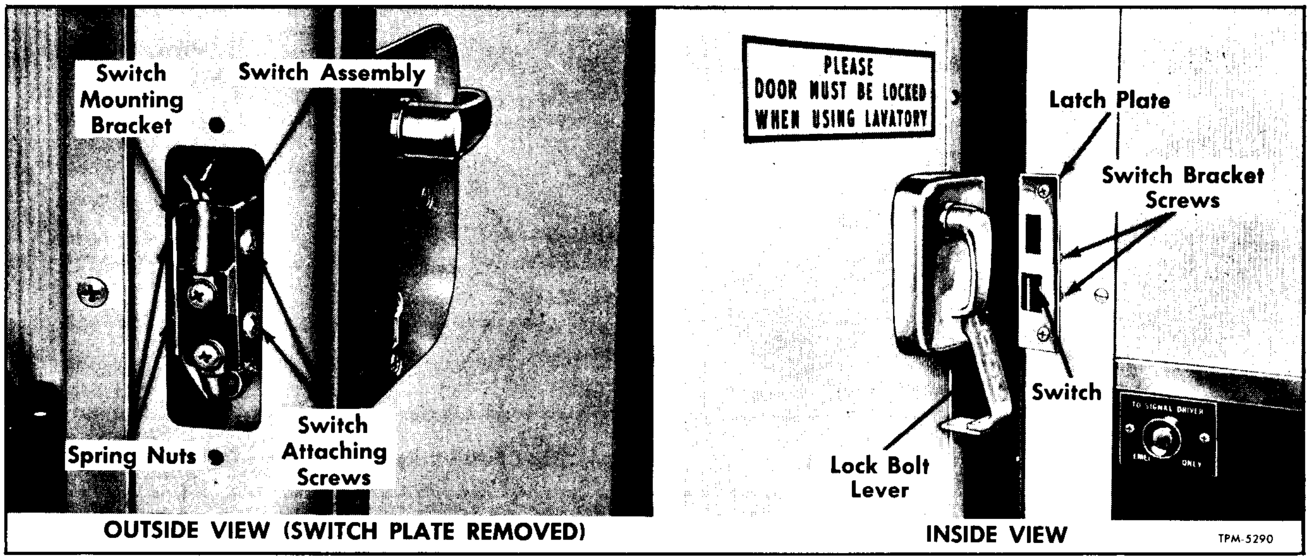


Figure 57—Compartment Door Lock and Switch Installed

ically the air breather assembly should be removed and washed in hot soapy water, then blown dry with air pressure. The check valve should also be removed, operation checked, disassembled and cleaned out. Operation can be checked by attempting to pass air through valve both ways. Air should pass through valve only in direction of arrow stamped on side of valve body. Right view of figure 64 shows components of valve.

IMPORTANT: When reinstalling valve make sure arrow on side of valve is pointed toward tank elbow.

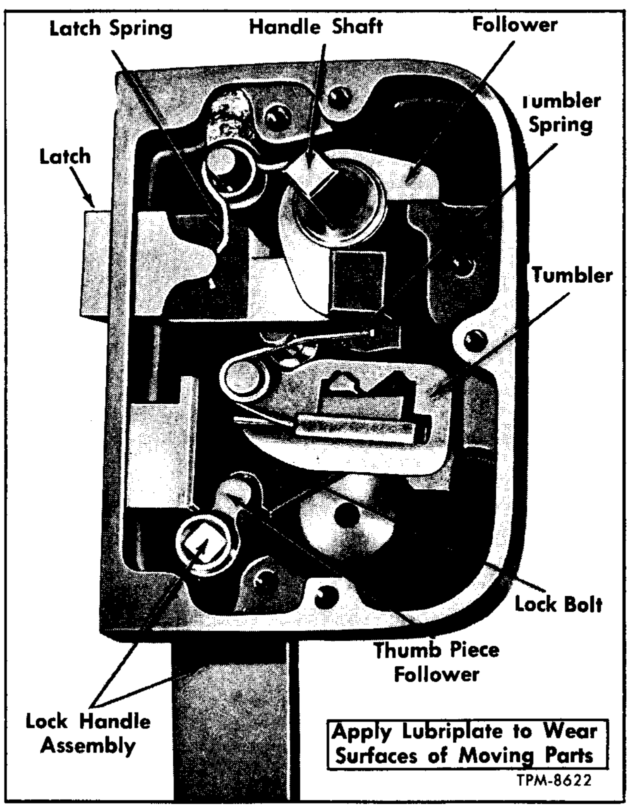


Figure 58—Lavatory Compartment Door Lock Components

Filling Supply Tank

1. Lift access door over service line fittings at right rear of coach (fig. 59), then connect water supply hose to front fitting marked "WATER SUPPLY TANK FLUSH AND FILL."

2. Fill supply tank with fresh water until

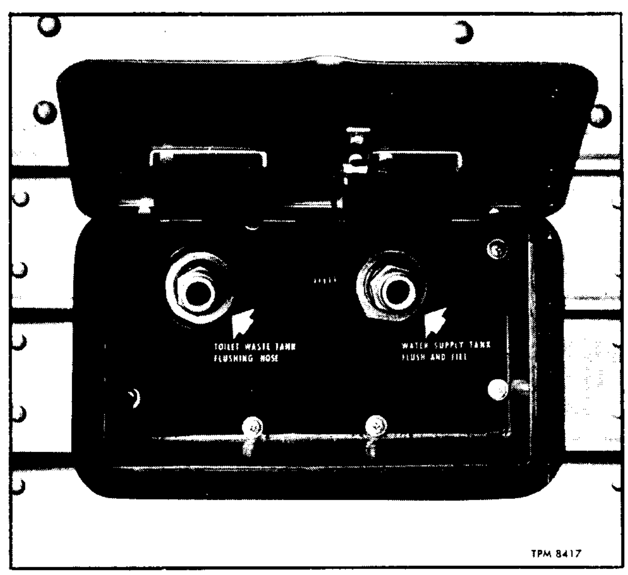


Figure 59—Lavatory Water Service Fittings

LAVATORY

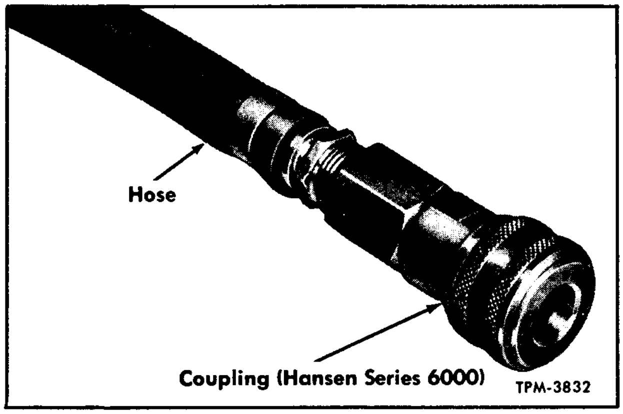


Figure 60—Service Hose and Coupling

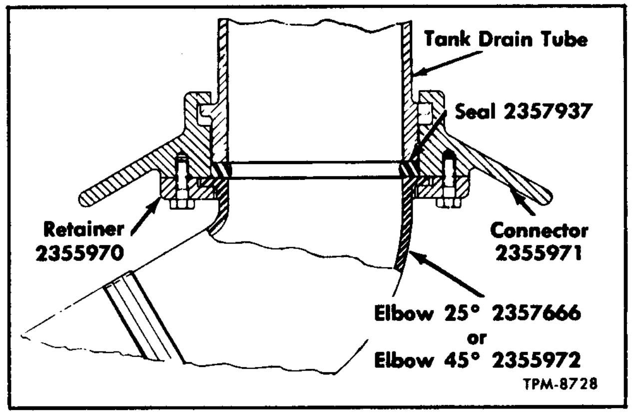


Figure 61—Chemical Tank Outlet and Quick-Lock Connector

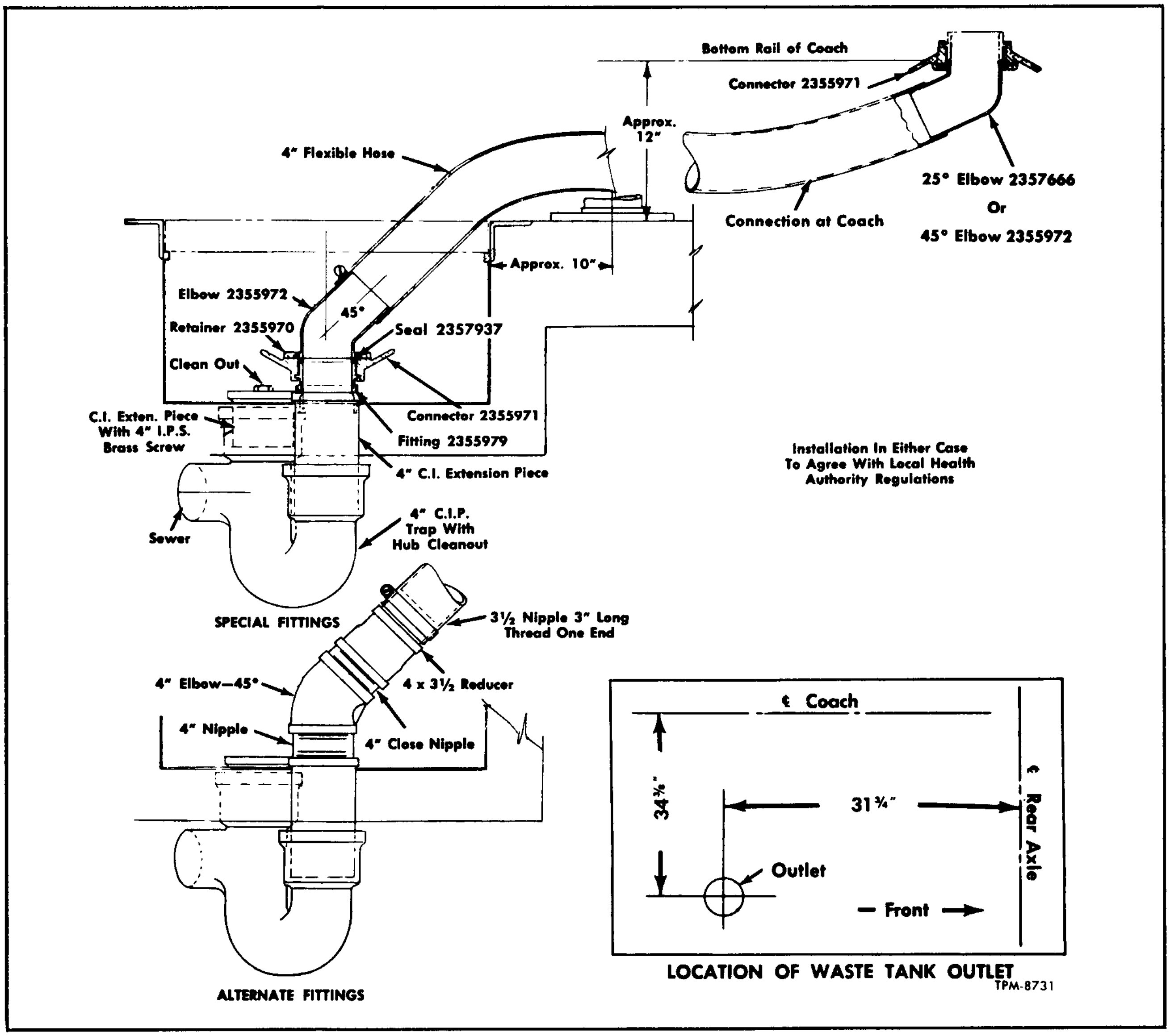


Figure 62—Chemical Tank Drain Connections (Typical)

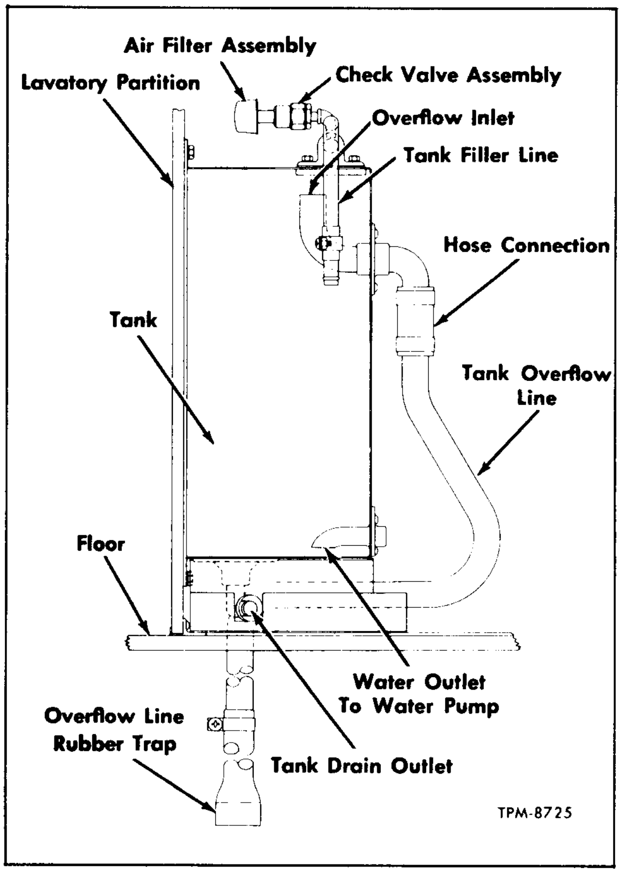


Figure 63—Wash Water Supply Tank Construction

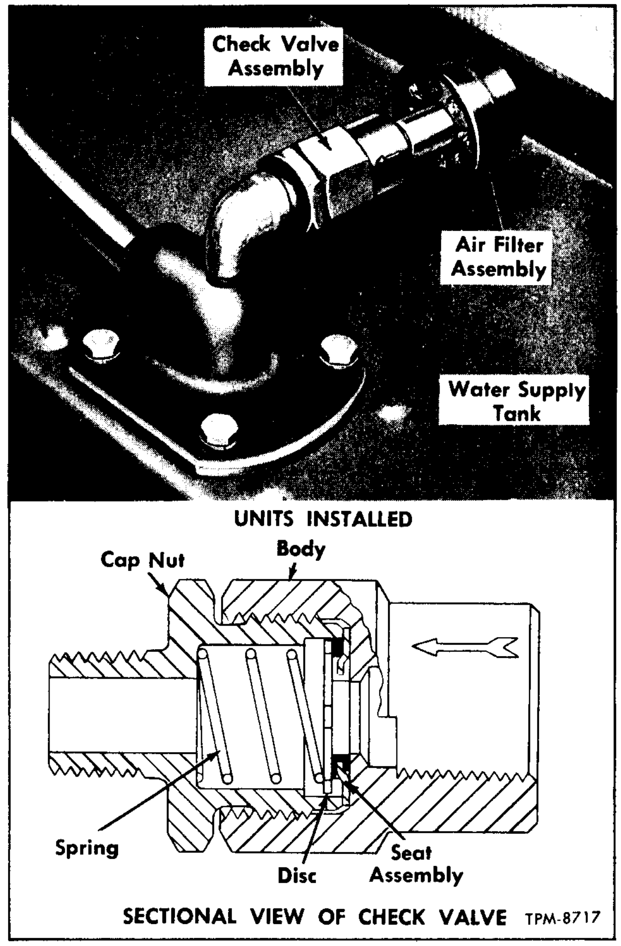


Figure 64—Water Supply Tank Air Breather and Check Valve Installed

water starts to flow out overflow line (18, fig. 53).

3. After filling tank, disconnect water supply hose, then close access door at service fittings.

Draining Water Supply Tank

1. At rear of right rear seat, open water supply tank drain valve (22, fig. 53) and allow water to drain into sewer opening or receptical.

2. If tank is to be flushed out, leave valve open and flush out tank using same procedure as for filling supply tank explained previously.

3. After either draining or flushing of tank close valve (22, fig. 53).

Flushing Supply Tank

Perform all the procedures previously explained for draining water supply tank.

LAVATORY CHEMICAL TANK

Draining Chemical Tank

1. Place coach over sewer opening and attach drain hose special quick-lock connector to tank outlet (figs. 61 and 62). If receptical or sewer facilities are not available, comply with local health regulations.

2. In lavatory compartment at front side of stool cover, unlock and open the chemical tank drain plug handle access cover (fig. 65). Pull handle up approximately six inches as shown; this action lifts large rubber drain plug (fig. 66) from opening in bottom of tank and permits tank to empty.

3. Leave drain plug out of tank drain opening until flushing operation or the draining of wash basin retention tank is completed.

Flushing Chemical Tank

NOTE: Make sure chemical tank drain plug is removed from bottom of tank.

1. Lift access door over service line fittings at right rear of coach (fig. 59), then connect water supply service hose to rear fitting marked "WATER WASTE TANK - FLUSHING HOSE."

2. Open water pressure into fitting, then within the lavatory compartment, open small door on riser panel at right of basin (fig. 67) for access to flexible flushing hose.

3. Remove hose from compartment, then di-

LAVATORY

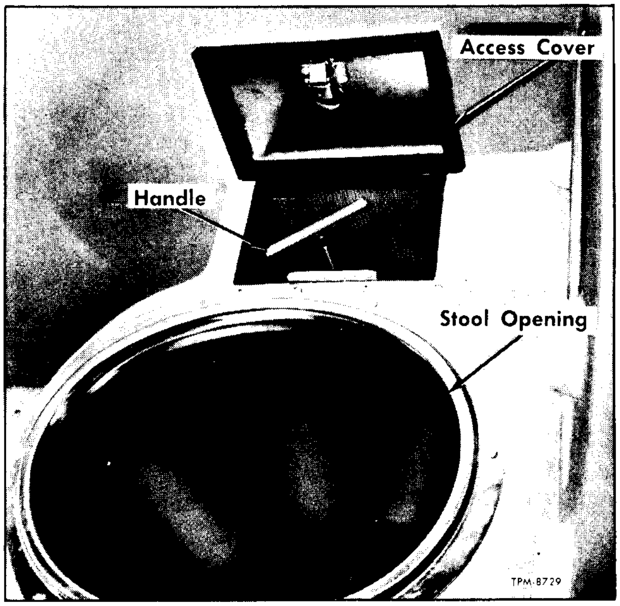


Figure 65—Access to Chemical Tank Drain Plug Handle

rect water spray into toilet stool and chemical tank until flushing is completed.

4. Leave water supply service hose connected until after tank is chemically treated.

Sealing Chemical Tank

1. Press chemical tank drain plug handle (fig. 65) down until handle rod stop is seated firmly to top of tank. This action will position drain plug into tank drain opening as shown in figure 66.

NOTE: If stop is positioned on handle rod to dimension shown, proper plug location in drain tube will be obtained. Close handle cover and lock.

2. Underneath coach, disconnect tank drain hose (fig. 61) (if used).

3. If tank drain plug does not seal satisfactory, expand plug diameter as directed below under "Chemical Tank Drain Plug Adjustment."

Chemical Tank Drain Plug Adjustment

Adjustment is made underneath coach at lower end of drain plug (fig. 66).

1. To prevent drain plug rod from turning while making adjustment, have assistant hold the drain plug handle in lavatory compartment.

2. Underneath drain plug, loosen lock nut, then turn adjusting nut until plug is expanded to a diameter which will provide a complete seal at opening. Turning adjusting nut clockwise will expand plug. Tighten lock nut firmly after making adjustment.

Filling and Treating Chemical Tank

NOTE: Before performing operation, make sure chemical tank drain plug is properly installed.

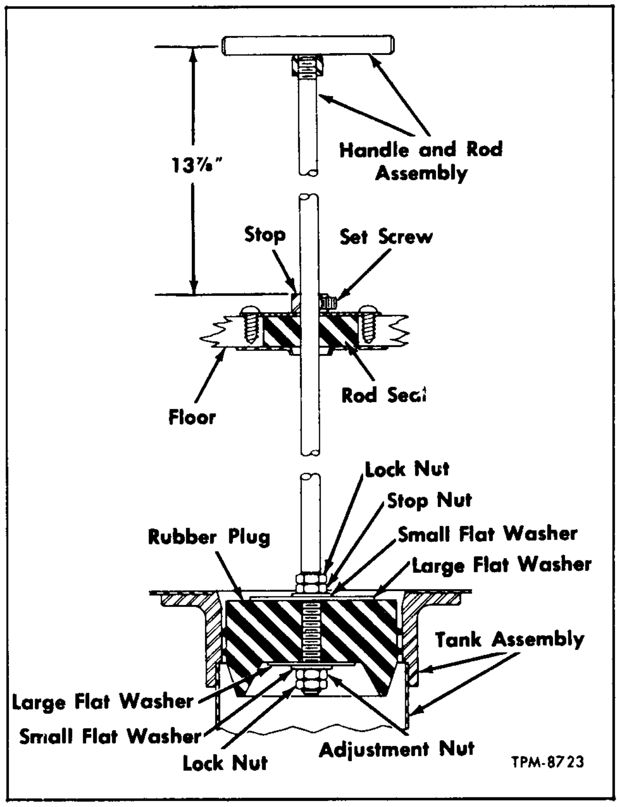


Figure 66—Chemical Tank Drain Plug and Handle Installation

1. Using hose (fig. 67) located in compartment under wash basin, fill chemical tank through lavatory stool with approximately 6-1/2 gallons of water. Tank holds approximately 12 gallons; however, it should only be partially filled as recommended.

NOTE: During operation in freezing weather, chemical tank can be serviced with salt water to prevent freezing.

2. Pour 1-1/2 pints of degerm chemicals into chemical tank through lavatory stool. Degerm chemical can be obtained from the Century Chemical Products Company, 520 West Fort St., Detroit, Michigan, and can be procured in 5 gallon cans, or 15, 30, and 55 gallon drums.

This chemical, mixed with water, will properly treat chemical tank.

WASH BASIN WASTE TANK

Draining into Chemical Tank

1. Through access door in paneling below wash basin (fig. 67), open drain valve which will allow waste water in tank to drain through line (12, fig. 53) into chemical tank. Remove basin drain plug when draining tank.

2. Close valve after draining.

DRAINING OF ENTIRE LAVATORY SYSTEM

System can be drained to prevent freezing or for other reasons as follows:

NOTE: Key numbers in following text refer to figure 53.

1. Place vehicle over proper drain catching facilities to comply with local health regulations.
2. Drain chemical waste tank by pulling up on drain plug handle (15) accessible within lavatory compartment at front of stool. Leave handle in raised position.
3. Through access door below wash basin, open basin waste tank drain valve (10) allowing this tank to drain into and out of chemical waste tank. Leave valve open.

NOTE: All the following drain points are accessible from behind right rear seat of coach.

4. Open water supply tank drain valve (22) allowing tank to drain.
5. Drain wash basin supply line by opening drain cock (20).
6. Drain supply tank service line by opening drain cock (21).
7. Drain wash basin water pump housing by opening drain cock (16).

NOTE: Leave all drain cocks open until system is to be refilled.

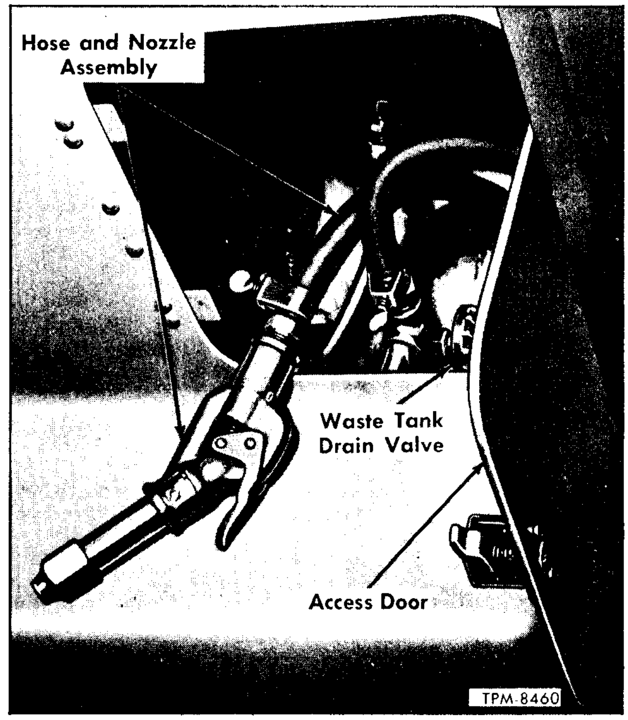


Figure 67—Location of Flushing Hose and Basin Waste Tank Drain Plug

VENTILATING BLOWER AND MOTOR

Ventilating blower and motor is mounted on ledge (fig. 54) behind lavatory compartment rear upper closure panel which can be readily removed by rotating retainer screws.

Blower motor brushes or the motor circuit fuse can be replaced without having to remove unit from mounting.

Blower and Motor Removal (Fig. 54)

1. Remove screw-lock retained closure panel from rear of lavatory compartment.
2. Disconnect wiring at fuse holder connector and taped connection.
3. Remove screws which attach blower shroud to ledge.
4. Loosen clamp attaching large flexible air inlet hose to blower shroud.
5. Remove bolts which attach motor hold-down strap to mounting bracket. Remove motor with fan and housing assembly.

Blower and Motor Installation (Fig. 54)

1. Referring to lower view of figure 54, examine motor mounting bracket rubber insulating washers. If washers are deteriorated or damaged in any way, replace washers. Make sure new washers are positioned as shown.
2. Place blower and motor into position. Install motor mounting strap, shroud-to-panel screws, and the air inlet flexible tube. Tighten hose clamp firmly.
3. Connect electrical wiring. IMPORTANT: Tape wiring connections securely.
4. Check motor operation.
5. Install closure panel to rear of lavatory compartment.

Disassembly and Assembly (Refer to Fig. 68)

1. Remove three screws which attach blower shroud to blower body. Remove shroud.
2. Loosen set screw which secures blower wheel to motor shaft.
3. Remove three nuts which attach blower body and mounting bracket to motor support.
4. Pull blower wheel from motor shaft being careful not to distort wheel. Separate parts.
5. Reassemble blower and motor in reverse sequence of above. Position rubber grommets and flat washers as shown. Before tightening blower wheel to blower shaft set screw, make sure blower wheel, when turning will not contact blower body.

WASH BASIN SUPPLY PUMP AND MOTOR

Supply pump and motor, located on floor in back of rear seat on right side of coach (fig. 55) can be readily removed for service; however, it is not necessary to remove pump and motor to replace motor brushes. Figure 69 shows brush retaining cap and brush with spring removed. Access

LAVATORY

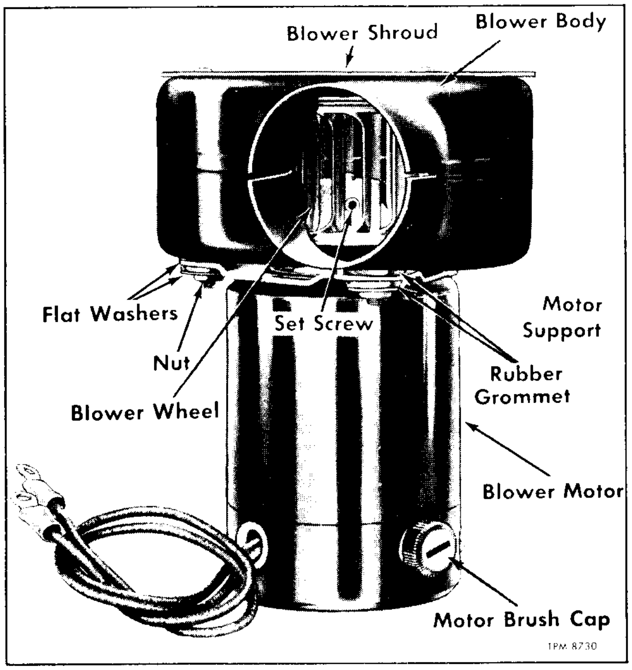


Figure 68—Blower and Motor Assembly Removed

to motor for replacing brushes can be obtained by removing rear seat inner cushion. To remove motor and pump, it is recommended that entire rear seat be removed.

Removal (Refer to Fig. 55)

1. Drain water supply tank as directed previously under "Wash Basin Water Supply Tank."
2. Disconnect electric wiring at motor.
3. Disconnect water lines at pump connections. (See view of removed unit.)
4. Remove bolts which attach pump bracket to floor. Remove pump and motor with mounting bracket and check valve (fig. 55).
5. Remove two bolts attaching mounting bracket-to-pump adapter flange. Remove bracket-to-flange gasket.
6. At outlet flange of pump, remove two bolts which attach outlet flange, and restriction plate to pump body. Remove plate, restriction plate and gaskets.

Disassembly, Inspection, and Repair

Refer to "Booster Water Pump" under "HEATING AND VENTILATION" for procedures which will apply, covering disassembly, inspection, repair, and assembly of pump and motor which is typical.

Installation (Refer to Fig. 55)

NOTE: Before installing gaskets to pump flanges make sure flange surfaces are clean and smooth, then apply permatex sealing compound to gasket surfaces and to all connection fittings.

1. At outlet flange, install new gaskets, restriction plate, and outlet flange, positioned as shown. Install 3/8 x 7/8" flange bolts evenly and firmly. NOTE: Restriction plate should have a 5/32" diameter hole at its center. Make sure hole is open.
2. At pump inlet adapter, install new gasket then attach pump mounting bracket to pump adapter with two 3/8 x 3/4" bolts and lock washers. Install line connector in mounting bracket.
3. To water outlet flange, assemble elbow, nipple, check valve, and line connector as shown.

IMPORTANT: Plug of water check valve must be positioned at top side. See illustration. Otherwise check valve ball will fail to seat in valve body, making valve useless.

4. Place unit to lines, then loosely connect water line connections and pump drain cock line. Attach pump bracket to floor. Final tighten all line connections.
5. Connect motor electrical wiring.
6. Fill supply tank, operate pump, and check for leaks.

WASH BASIN SUPPLY LINE CHECK VALVE

Check valve is installed in basin supply line as shown in figure 55. Valve is of ball-type, and serves to maintain a full supply line to basin faucet, thus preventing a delayed surge of water after pressing water pump switch.

When a delayed surge occurs, the valve should be cleaned and inspected as follows:

1. Remove seat inner cushion from right rear seat and drain the wash basin supply tank.
2. Pack pieces of cloth under and around top of valve body to soak up water in line and drain basin water supply tank.
3. Using a 9/16" open-end wrench, remove plug from top of valve body. Remove check ball.
4. Examine check ball for pitted or damaged condition. Replace check ball if necessary.
5. Clean out valve body, install check ball and reinstall valve plug. Tighten plug firmly.

SOAP DISPENSER

When soap dispenser supply tank requires filling, turn plunger cap which is threaded into dispenser body, then remove cap. With cap removed, pour liquid soap into tank until full, then thread plunger cap into dispenser body.

EMERGENCY BUZZER

Lavatory emergency buzzer, mounted under dash in front of driver (fig. 56), sounds only when emergency switch in lavatory compartment is pressed. Refer to "Lavatory Wiring Diagram - MD-89108" in back of this manual for circuit continuity.

Maintenance

At regular intervals, remove cover of buzzer and inspect points for burning, corrosion, or other defects. Clean or replace points as necessary.

Tests

If buzzer fails to operate, when switch button is pressed, proceed as follows:

1. Make sure points are clean and in contact and that terminal screws are tight.
2. Use voltmeter and test for current at feed terminal. When no current is obtained, circuit is open between No. 6 circuit breaker and buzzer terminal.
3. When current is obtained at buzzer feed terminal, and buzzer still fails to sound, check for current at opposite terminal. When no current can be obtained at this terminal buzzer coil is probably open circuited. If current is obtained, ground terminal with a jumper wire and if buzzer sounds, switch circuit is defective. If buzzer still fails to sound it can be considered defective and should be replaced.
4. When foregoing tests indicate that buzzer is satisfactory, remove switch button; then ground wire leading to buzzer. If buzzer sounds, switch is defective and should be replaced. If buzzer fails to sound, wiring between switch and buzzer is defective.

DOOR LOCK SWITCH

Switch mounted in partition at front of lavatory compartment door (fig. 57) is adjustable in or out to make contact with door inside lock bolt when lock lever is positioned for locking door.

Switch Adjustment (Fig. 57)

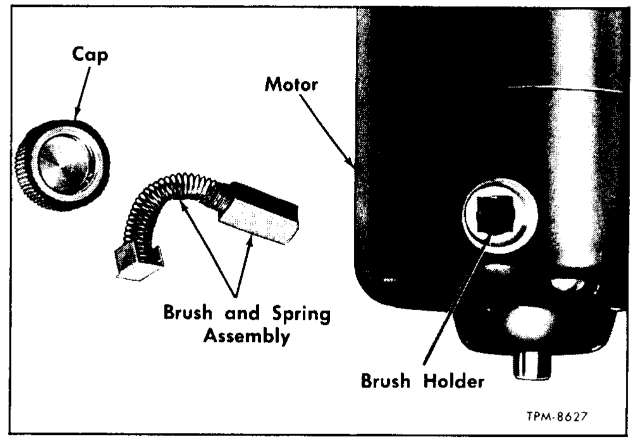


Figure 69—Water Pump Motor Brush Assembly Removed

1. Remove two cross-recessed screws which attach switch cover plate to front partition, then remove plate.
2. Inside the compartment, remove two screws which attach switch bracket to partition. Pull switch and bracket from front opening.
3. Loosen two screws which attach switch to mounting bracket having two attaching screw slots purposely at back side for adjusting switch position. Squeeze bracket and switch to ends of slots. Tighten switch screws firm, but not excessively, in spring nuts. Reinstall switch and bracket to partition.
4. From inside lavatory compartment, close door and lock. NOTE: Extra effort will be required to lock door first time as action will force switch to proper position on mounting bracket. Switch will be retained in position by attaching screw spring nuts. Check switch operation.
5. Reinstall switch cover and latch plate.

SPECIFICATIONS

WATER SUPPLY TANK
Capacity .... 10 gal.

WASH BASIN DRAIN TANK
Capacity .... 11.4 gal.

CHEMICAL WASTE TANK
Total Capacity .... 12 gal.
Water Required After Cleaning .... 6½ gal.

WATER PUMP MOTOR
GM Part Number 2326049
Make .... Universal Electric
Model 8-025
Type .... Series Wound
Volts .... 12 DC
Amperes 5
Rotation (Shaft End) .... Clockwise
RPM 3400

VENTILATION BLOWER MOTOR
GM Part Number 2361146
Make .... Universal Electric
Model 4-107
Type .... Series Wound
Volts .... 12 DC
Amperes 3
Rotation (Shaft End) .... Clockwise
RPM 3000

PASSENGER EMERGENCY SIGNAL BUZZER
Make .... Delco-Remy
GM Part Number 1116882

WATER PUMP TIME DELAY RELAY
GM Part Number 2395216
Make .... Eagle Signal Co.
Eagle Part Number AF40S8X1
Volts 12
Switch .... Single-pole, Double-throw
Timing .... 20 seconds

Brakes

This group contains maintenance and repair information on BRAKES. The three sections of the group are shown in index below:

Air Brakes

AIR SYSTEMS

Air system in coach is made up of a group of devices. Some of these devices maintain a supply of compressed air, some direct and control the flow of compressed air, and others transform energy of compressed air into the mechanical force and motion necessary to accomplish their particular function. Only those units with functions directly related to the vehicle braking system are covered in this section. Information on other air system units will be found in other sections of this manual as shown later under "Index of Air Control Units."

To simplify the following explanation, the air system (fig. 1) will be divided into four interconnected systems: Main Air System, Auxiliary Air System, Air Suspension Air System, and Engine Stop and Radiator Shutter Control System. Each system is described separately below:

MAIN AIR SYSTEM

The main air system supplies and controls air pressure for operation of the vehicle braking system. It also supplies air pressure to the auxiliary air system after pressure has been built up to a point sufficient for safe operation of brakes, and to the engine stop and shutter control system.

AUXILIARY AIR SYSTEM

The auxiliary air system supplies air pressure to the air suspension system, air horn, windshield wipers, and heating system controls. The air pressure gauge on gauge panel is also connected to the auxiliary air system.

AIR SUSPENSION AIR SYSTEM

Air suspension air system includes the height control valves, air beams, and air bellows. This system is illustrated in more detail and is fully described in AIR SUSPENSION (SEC. 14) of this manual.

ENGINE CONTROL SYSTEM

Engine stop and shutter control air system is supplied directly from the main air system. Units used are covered in other sections of this manual as indicated later under "Index of Air Control Units."

OPERATION

MAIN AIR SYSTEM

Compressed air, supplied by the air compressor, is discharged through the discharge muffler into the rear (wet) air tank. Compressed air is directed from this tank into the front main (dry) air tank. Air line leading from top of front tank delivers air pressure to the rear of the vehicle for operation of the air compressor governor, and supplies air to the engine stop and shutter control system. Two air lines lead from a tee at left end of front air tank. One line delivers air pressure to the rear brake relay valve; the other line delivers air pressure to the brake application valve, low air pressure switch, and by way of the pressure regulating valve, to the auxiliary air tank.

The pressure regulating valve permits air pressure to pass into the auxiliary air tank when pressure in the main air system reaches 65 psi. The low air pressure switch closes an electrical circuit in the tell-tale alarm system when pressure in the main air system is below the valve setting (60 psi, plus or minus 6 psi). This causes the buzzer to sound and the low air pressure tell-tale to light.

When brakes are applied, air pressure passes through the brake application valve to the front brake chambers, stop light switch, and relay valve. Pressure to relay valve only operates the valve, permitting air pressure direct from air tank to pass through the valve into the rear brake chambers.

When brakes are released, air pressure in the rear brake chambers is exhausted at the relay

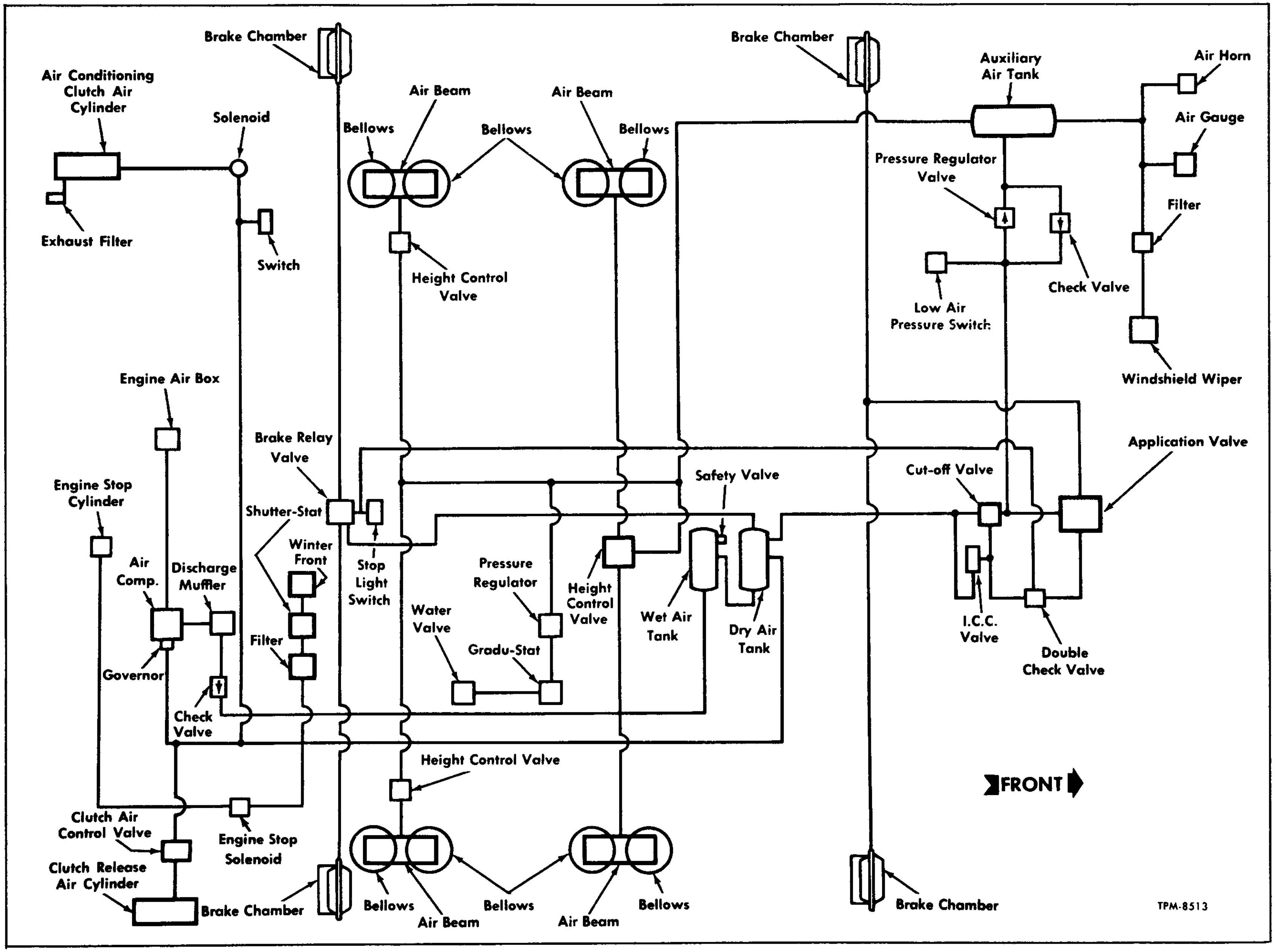


Figure 1—Air Line Diagram

valve. Air pressure in front brake chambers, stop light switch, and line leading to relay valve is exhausted at the application valve.

AUXILIARY AIR SYSTEM

No air pressure is admitted into the auxiliary air system until pressure in main air system reaches 65 psi. When pressure reaches 65 psi, the pressure regulating valve permits air pressure to pass into the auxiliary air tank. Two air lines lead from a tee at top of auxiliary air tank. One line delivers air pressure to the air suspension height control valves, and the other delivers air pressure to the air horn foot valve, windshield wiper control valves, and air pressure gauge.

When pressure in the main air system drops below 65 psi, compressed air in the auxiliary air system returns to the main air system through the one-way check valve. Air in suspension system, however, is not released. Check valves in height control valves prevent air in suspension system from returning to auxiliary system.

INDEX OF AIR CONTROL UNITS

Unit	Sec.	Unit	Sec.
Air Horn	3	Valve, Brake Application	4
Bellows, Air	14	*Valve, Combined Limiting and Quick Release	4
Brake Chambers	4	*Valve, Moisture Ejector	4
Check Valve, Aux. Air System	4	*Valve, Front Brake Limiting	4
Check Valve, Discharge Line	4	Valve, Height Control	14
Compressor, Air	4	Valve, Aux. Brake Control (I.C.C.)	4
Cylinder, Engine Shut-off	8	Valve, Pressure Regulating (Aux. Air System)	4
*Cylinder, Radiator Shutter		Valve, Pressure Regulating (Heating System)	3
*Filter, Shutter Air		Valve, Rear Brake Relay	4
*Filter, Windshield Wiper Air		Valve, Safety	4
Gauge, Air Pressure	4	Valve, Water Modulating	3
Governor, Air Compressor	4	Valve, Windshield Wiper	3
Grad-U-Stat	3	Valve, Cut-off	4
Magnet Valve, Engine Shut-off	8	Valve, Air Line Test	4
Muffler, Compressor Discharge	4	Valve, Air Line Check	4
Switch, Low Air Pressure	4	Valve, Double Check	4
Switch, Stop Light	7	Windshield Wipers	3
Tanks, Air	4		
*Thermostat, Shutter			
Valve, Air Horn	3		

*Special equipment.

BRAKE SYSTEM MAINTENANCE

Procedures for testing, adjusting, and overhauling the various units in the air brake system are described under individual headings later in this section.

It is imperative that all air tanks without moisture ejector valves and air compressor discharge muffler be drained daily to discharge any condensation which has collected. Refer to "Air Tanks" later in this section for location of air tanks and drain cocks.

The complete air system should be checked for leakage at regular intervals. With engine stopped and brakes released, observe rate of air pressure drop registered by the dash gauge. The rate of drop should not exceed two pounds per minute. With engine stopped and brakes fully applied, observe the rate of air pressure drop registered by the dash gauge. Rate of drop should not exceed three pounds per minute. If leakage is excessive, leakage tests should be made at air line connections and at all air brake control units as directed under individual headings later in this section.

In cold weather, particular attention should be given to draining moisture from the air system. When necessary to protect the system against freezing as in cases of extreme cold weather, an alcohol evaporator should be used to introduce alcohol vapor into the system.

Refer to "AIR COMPRESSOR AND GOVERNOR" section later in this group for information on air compressor and governor.

BRAKE ADJUSTMENTS

BRAKE SHOE ADJUSTMENT

Brake adjustment for normal lining wear is made by turning slack adjuster worm shaft (fig. 19). Brake chambers and slack adjusters installed are shown in figures 20 and 21. Brake chamber push rod travel should be checked after every 2,000 miles of operation to determine whether adjustment is necessary. While maximum travel, listed

AIR BRAKES

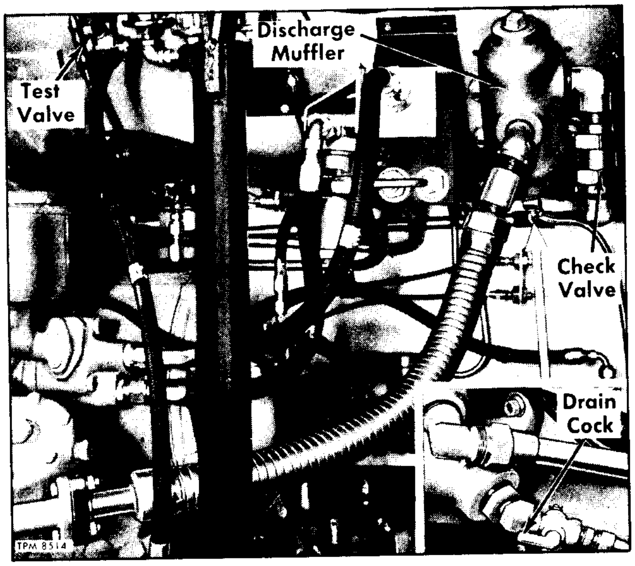


Figure 2—Air Compressor Discharge Muffler Installed

in "Specifications" at end of this group, is permissible, travel should be maintained as short as possible without brakes dragging for braking efficiency and economy in air consumption. Brake linings should be replaced when worn to a thickness of 5/16" at center of shoe.

1. Always check wheel bearing adjustment and correct if necessary, before attempting to adjust brakes. Refer to "HUBS AND BEARINGS" (SEC. 19) of this manual.

2. With wheel jacked up, turn slack adjuster worm shaft until brake drags; then back off until wheel turns freely. NOTE: Lock sleeve must be pushed in before worm shaft can be turned. Make sure sleeve is pushed in far enough to clear hex end of worm shaft before turning shaft.

3. Be sure wheel turns freely with no brake drag when brakes are fully released. After completing adjustment, make sure lock sleeve comes out and engages hex end of worm shaft. Pry sleeve out with screwdriver if necessary. Coat lock sleeve and end of worm shaft with wheel bearing grease after completing adjustment. This keeps out dirt and water, and assures free movement of sleeve at next adjustment.

NOTE: Check brake adjustment; if brakes are properly adjusted, brake chamber push rod travel should be 5/8"-3/4" - front and 1-1/8"-1-1/4" - rear. Use pinch bar to check travel. DO NOT USE AIR PRESSURE.

BRAKE TREADLE ADJUSTMENT

1. Loosen lock nut and screw stop bolt in several turns.

2. Push brake treadle down to limit of its travel and adjust stop bolt to this position.

3. From full down position, raise treadle two full turns of stop bolt. This clearance protects valve parts from damage.

5. Adjust stop screw to provide 0.001" to 0.002" clearance between treadle roller and plunger, with treadle held tight against stop screw. Tighten lock nut.

AIR COMPRESSOR DISCHARGE MUFFLER

Air compressor discharge muffler (fig. 2), mounted in engine compartment above transmission, is connected by a flexible air line to the air compressor discharge fitting. Purpose of muffler is to arrest the pulsation noises (ping) caused by discharge of compressed air from the reciprocating air compressor.

Since the discharge muffler is the first unit hot compressed air enters, considerable condensation collects in the unit. This condensation must be drained daily. Drain cock and drain tube are installed at lower side of muffler. Drain cock is open with handle at right angle to body, and is closed with handle parallel to body.

Muffler should be removed at regular intervals and the inside cleaned of carbon deposits or other foreign material.

AIR TANKS

Three air tanks are used in vehicle air system, two main tanks and an auxiliary tank. The purpose of the air tanks is to provide a place to store compressed air so that there will be an ample supply available for immediate operation of brakes and other air-operated equipment. Air tanks also provide storage for sufficient compressed air for several brake applications with engine stopped.

Another purpose of the tanks is to provide a place where the air heated during compression can cool, and the oil and the water vapors can condense. Most of this condensation takes place in the rear or "wet" tank. The moisture ejector valve (fig. 5) when used, automatically drains condensation from the rear tank. If moisture ejector valve is not used, the rear tank as well as front and auxiliary air tanks must be drained manually each day. To drain tanks properly, leave drain cocks open until all air escapes and until draining stops.

All air tank mounting bolts should be checked for looseness at regular intervals, and tightened if necessary. Air tanks may be cleaned inside using steam or hot water. Inspect tank for corrosion or other damage. If corrosion or other damage has weakened the tank, it must be replaced. Location of each air tank is described below.

Rear Tank

Rear (wet) air tank is installed in a vertical position at front center of coach behind the front (dry) air tank. Drain cock at bottom of tank is recessed key type. A special tool, which can be made locally, or a large L-shaped screwdriver must be used to open and close drain cock. Dimensions for making tool are shown in figure 3.

Front Tank

Front (dry) air tank is mounted horizontally under floor in back of spare tire compartment, and is accessible from under vehicle. Drain cock is installed in center of tank at bottom. Drain cock is closed with handle at right angle to body, and open with handle parallel to body.

Auxiliary Tank

Auxiliary air tank is mounted horizontally in top of compartment at left front corner of vehicle, and is accessible after opening compartment door. Drain cock, with drain tube extending through the compartment floor, is installed in bottom of tank. Drain cock is closed with handle parallel to body, and open with handle at right angle to body.

SAFETY VALVE

A safety valve, shown in figure 4, is installed in the rear air tank to eliminate the possibility of air pressure building up in the system beyond a set maximum. On some coaches a safety valve is installed in the air compressor discharge muffler.

OPERATION

When reservoir pressure is built up to exceed 150 pounds, force of air pressure forces ball (3) off seat (2), permitting air pressure in excess of 150 pounds to escape through exhaust port (4) to atmosphere. After pressure bleeds down, spring (5) forces ball (3) back on seat (2).

OPERATING TEST

The safety valve may be tested to be sure it is operating properly, by pulling on exposed end of the valve stem. This removes the spring load from the ball and permits the valve to exhaust. If the safety valve does not "blow off" when this is done, ball must be stuck on its seat. The valve should then be removed and overhauled.

MAINTENANCE

Check safety valve periodically for leakage, using soap suds at exhaust port. Leakage should not exceed a 1-inch bubble in 5 seconds at 90 psi. Once a year, valve should be dismantled, cleaned with kerosene, and reset to blow off at 150 pounds.

SAFETY VALVE OVERHAUL

Disassembly

1. Remove lock nut from adjusting screw; then screw adjusting screw out of spring cage.
2. Remove spring, spring seat, valve stem, and ball valve from spring cage.
3. Remove spring cage from valve body.

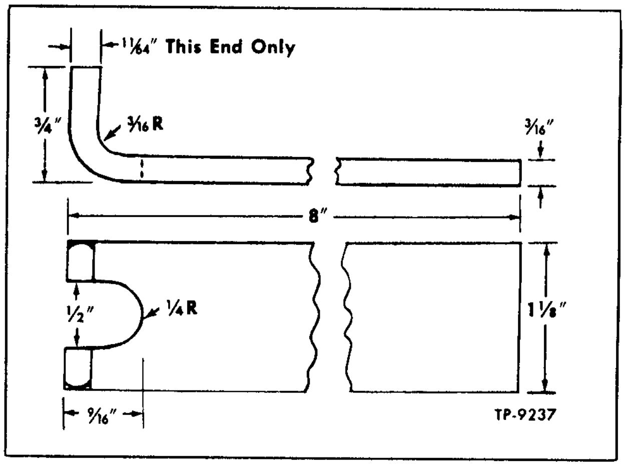


Figure 3—Special Tool for Recessed Type Drain Cock

Cleaning and Inspection

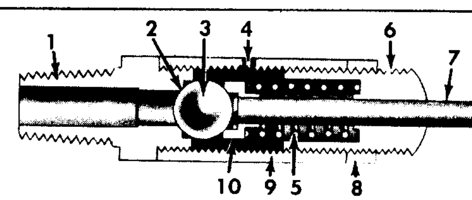
1. Clean all parts in cleaning solvent. Wipe or blow parts dry.
2. Examine ball valve for signs of pitting or scratches.
3. Check for crossed or stripped threads on adjusting screw, spring cage, and valve body.
4. Inspect valve body and spring cage for cracks or damage. Be sure exhaust port in spring cage is not damaged.
5. Replace all parts that are not in good condition.

Assembly

1. Screw spring cage on valve body; then install ball valve, stem, spring seat, and spring cage in that order.
2. Turn adjusting screw into spring cage and install lock nut.

Adjustment (Fig. 4)

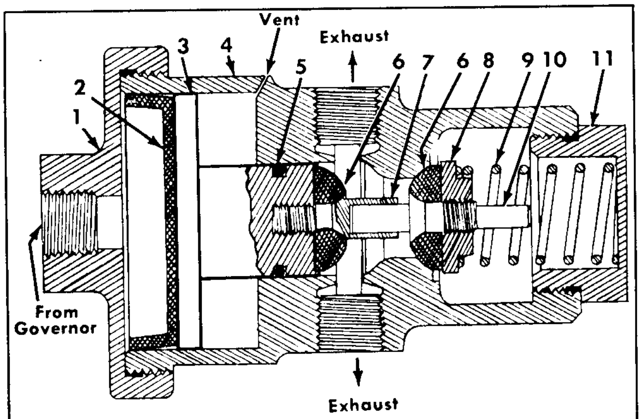
Set safety valve in following manner:
1. Loosen lock nut (8).



1 Body
2 Ball Seat
3 Ball Valve
4 Exhaust Port
5 Spring
6 Adjusting Screw
7 Stem
8 Lock Nut
9 Spring Cage
10 Spring Seat

TPM-8579

Figure 4—Safety Valve



1 Cylinder Cap
2 Cup
3 Piston
4 Body
5 O-ring
6 Seat
7 Piston Stem
8 Seat Washer
9 Valve Spring
10 Valve Stem
11 Spring Cap

TPM-7201

Figure 5—Moisture Ejector Valve (Graham-White)

2. Adjust set pressure by turning adjusting screw (6). Turn screw clockwise to increase pressure, or counterclockwise to decrease pressure.

3. Tighten lock nut (8).

MOISTURE EJECTOR VALVE (GRAHAM-WHITE)

DESCRIPTION (Fig. 5)

The moisture ejector valve used on some coaches, is bolted to a bracket above rear (wet) tank beneath coach floor. Most of the condensation takes place in the wet tank. This condensation is automatically drained through the ejector valve.

OPERATION

Moisture ejector valve operates each time the governor unloads the air compressor. Air pressure from governor works against ejector valve cup. This force moves piston, compresses valve spring, and unseats exhaust valve. Air pressure in wet tank forces accumulated moisture into valve and out through two drain lines. At end of piston stroke, opposite seat makes contact and closes valve.

SERVICEABILITY TESTS

1. Operating Test

Build up tank pressure in air system. At cut-out point (120 psi), air pressure from governor unloads compressor and also operates ejector valve.

2. Leakage Test

Coat open end of both drain lines with soap solution. The presence of soap bubbles will indicate leakage past valve seat. Disassemble unit and clean or replace exhaust valve.

EJECTOR VALVE REPLACEMENT

Removal

1. Exhaust compressed air from system.
2. Disconnect air lines and drain lines.
3. Remove two bolts and lock washers connecting ejector valve to mounting bracket. Remove ejector valve assembly.

Installation

1. Align bolt holes in valve body with holes in mounting bracket.
2. Install two bolts and two lock washers. Tighten firmly.
3. Connect air lines and drain lines. Build up pressure in system and test valve as previously directed under "Serviceability Tests."

EJECTOR VALVE OVERHAUL

Disassembly

Key numbers in text refer to figure 5.

1. Unscrew spring cap (11) and remove from valve body (4).
2. Remove valve spring (9) and intake valve assembly, consisting of seat (6), seat washer (8), and valve stem (10) as an assembly, from valve body.
3. Turn seat washer (8) off valve stem (10). Remove seat (6) from valve stem (10).
4. At opposite end of the assembly, unscrew cylinder cap (1) and remove from valve body (4).
5. Push on piston stem (7) and remove cup (2), piston (3), O-ring (5), seat (6), and piston stem (7) from valve body (4).
6. Unscrew piston stem (7) from piston. Remove seat (6).
7. Remove O-ring (5) from piston and discard

Inspection

1. Clean all parts thoroughly with cleaning solvent. Wipe or blow parts dry.
2. Examine cylinder cap, valve body, and spring cap for cracks, stripped threads, or other damage.
3. Check vent in valve body for obstruction.
4. Inspect valve cup, piston, seat washer, and seats for wear or damage.
5. Check valve stem and piston stem for distortion, stripped threads, or other damage.
6. Inspect valve spring for free length, compressed length, distortion, or collapsed coils.

Assembly

Key numbers in text refer to figure 5.

1. Install a new O-ring (5) in groove of piston (3).
2. Position seat (6) to piston (3); then thread piston stem (7) into piston (3).
3. Insert piston assembly in valve body (4).
4. Install cup (2) in body (4); then thread cylinder cap (1) on valve body. Tighten firmly.
5. Position seat (6) on valve stem (10); then thread seat washer (8) on stem.
6. Install intake valve assembly, consisting of parts assembled in step 5 above, in valve body (4).
7. Position valve spring (9) against seat washer (8) in valve body.
8. Thread spring cap (11) into valve body (4). Tighten cap firmly.

AIR LINES

Metal tubing and flexible hose are used to connect the various units of the air brake system. Service instructions for both types to follow:

METAL TUBING

Metal air lines are of annealed copper tubing with three-piece compression type fittings. Flared type fittings should never be used in air brake systems. Connections should be tested for leakage at least every 5,000 miles and tightened or replaced if necessary. When replacing metal tubing, tubing must be free of burrs, copper cuttings, and dirt. Blow out with compressed air. Any of the above mentioned particles will destroy sealing seats in air control units. New tubing must be of the same size as the old tubing.

FLEXIBLE HOSE

Flexible hose is used at each brake chamber where it is impossible to use metal tubing due to constant flexing during vehicle operation. Hose connections should be tested for leakage at least every 5,000 miles and tightened or replaced if necessary. Any hose which is chafed, worn, or kinked should be replaced.

SERVICEABILITY TESTS

1. Operating Test

If any trouble symptom such as slow brake application or slow brake release, indicates restricted or clogged air line, disconnect the suspected tube or hose at both ends and blow through it to make sure the passage is clear. Inspect tubing and hose for partial restriction such as would be caused by dents or kinks. If such a condition is found, tubing or hose should be replaced.

2. Leakage Test

With air system fully charged and brakes applied, coat all tubing and hose connections with soap suds to check for leakage. No leakage is permissible. Leakage can sometimes be corrected by tightening the connection. If this fails to correct leakage, new fittings, metal tubing, or flexible hose must be installed.

AIR PRESSURE GAUGE

The air pressure gauge in the instrument panel is connected into the air lines supplied by the auxiliary air tank. Since the gauge receives its air pressure from the auxiliary air tank, it will register no increase in pressure until the pressure in the main air brake system is built up above 65 pounds; however, the gauge will register a decrease in pressure, regardless of pressure in system, since pressure in auxiliary air system returns to main air brake system as the pressure in the latter system is reduced.

The vehicle should never be put in motion until the air pressure registers at least 65 pounds. If pressure drops below 60 pounds (low pressure buzzer sounds), stop vehicle immediately and determine cause of pressure loss. Check gauge regularly with an accurate test gauge. Replace unit if reading varies four pounds or more.

DISCHARGE LINE CHECK VALVE

One-way check valve (fig. 6) is installed in air compressor discharge line at the outlet of the compressor discharge muffler (fig. 2). This valve performs no function in the air system except as a safety device. In the event of leakage or breakage

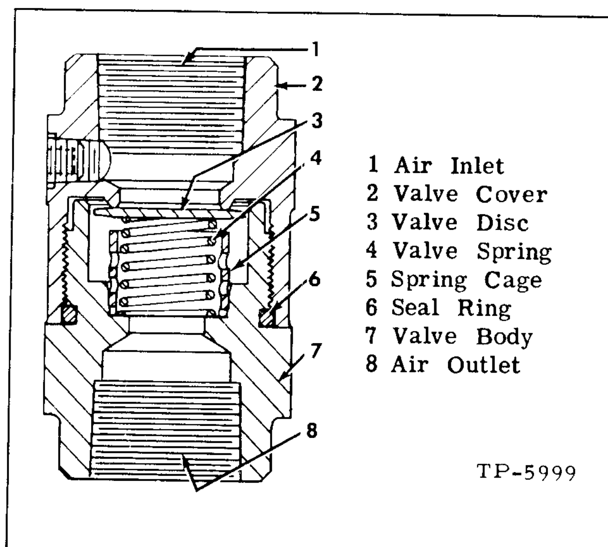
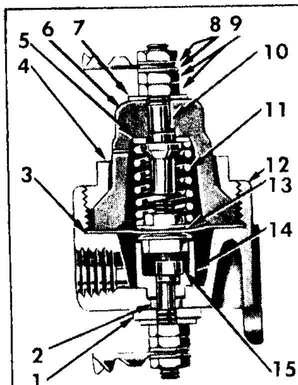


Figure 6—Discharge Line Check Valve



1 Terminal Washer
2 Grommet
3 Diaphragm Assembly
4 Cover Retainer
5 Washer
6 Cover
7 Clamping Washer
8 Washers
9 Nuts
10 Terminal Screw
11 Spring
12 Body
13 Shims
14 Terminal Bushing
15 Terminal Screw

TP 5468

Figure 7—Low Air Pressure Switch

in the line from air compressor to muffler, check valve prevents loss of air pressure from the air system. Check valve should be removed, disassembled, and cleaned at regular intervals. Valve disc should be turned over if worn on one side, and a new seal ring should be used when assembling the valve. When installing check valve, make sure it is installed to permit air flow in direction of arrow on valve body.

DISCHARGE LINE CHECK VALVE REPLACEMENT

Removal

1. Exhaust air pressure from air system by opening drain cock in one of the main air tanks.
2. Disconnect check valve from elbows at discharge muffler and discharge line. Remove valve.

Installation

1. Connect check valve to elbows at discharge muffler and discharge line, using Permatex on all threads. Tighten fittings securely.

NOTE: Be sure check valve is installed correctly, to permit air flow in direction of arrow on valve body.

2. Build up air pressure in system to normal operating pressure.

DISCHARGE LINE CHECK VALVE OVERHAUL

Disassembly

Key numbers in text refer to figure 6.

1. Unscrew valve cover (2) from valve body (7). Remove valve disc (3), valve spring (4), and spring cage (5).
2. Remove seal ring (6) from groove in valve body (7). Discard seal ring.

Cleaning and Inspection

1. Clean all parts in cleaning solvent. Wipe or blow parts dry.
2. Inspect valve cover and valve body for damage. Check for crossed or stripped threads.
3. Check valve spring for free length, compressed length, distortion, or collapsed coils.
4. Inspect valve disc for wear or damage. Replace disc if not in good condition.

Assembly

Key numbers in text refer to figure 6.

1. Install new seal ring (6) in groove of valve body (7).
2. Position spring cage (5) and valve spring (4) in valve body (7).
3. Place valve disc (3) over spring (4); then screw valve cover (2) on valve body (7), using Permatex on threads. Tighten cover on body securely.

LOW AIR PRESSURE SWITCH

Low air pressure switch (fig. 7) is a safety device designed to automatically give a warning when pressure in air system falls below a safe limit for brake operation. The low air pressure switch is actually an air controlled switch in an electrical circuit, automatically controlling a tell-tale light and buzzer. Operation of tell-tale alarm system is explained in "WIRING AND MISCELLANEOUS ELECTRICAL" in ELECTRICAL (SEC. 7) of this manual. Low air pressure switch is mounted in compartment at left front corner of vehicle, and is connected into the feed line to the brake application valve. Refer to "Alarm and Signal Wiring Diagram" in back of this manual, for electrical circuits.

OPERATION (Fig. 7)

When system air pressure under the diaphragm is above 60 pounds, force exerted by the air pressure overcomes force exerted by the diaphragm spring above the diaphragm, and electrical contacts open.

When air pressure drops below 60 pounds, the diaphragm spring exerts a force above the diaphragm which is greater than force exerted by air pressure below the diaphragm. This will cause the diaphragm to move down and close the electrical contacts. This completes electrical circuit to buzzer and tell-tale light, informing driver of his impending loss of air pressure.

The nominal pressure setting of 60 pounds is subject to a tolerance of plus or minus 6 pounds so that the actual operating pressure of the low air pressure switch may vary between 66 pounds maximum and 54 pounds minimum.

SERVICEABILITY TESTS

1. Operating Test

Operation of the low air pressure switch may be checked by reducing the system pressure and being sure that the contacts close when reservoir pressure is between 66 pounds maximum and 54 pounds minimum. The contacts will be closed when the tell-tale light and electrical buzzer operate.

2. Leakage Test

A small vent hole is provided in the cover of the low air pressure switch to check condition of the diaphragm. Cover vent hole with soap suds. If a leak is indicated it signifies a ruptured diaphragm. The diaphragm should then be replaced.

LOW AIR PRESSURE SWITCH REPLACEMENT

Removal

Exhaust air pressure from main air system. Disconnect wires from terminals at both ends of switch and disconnect air line from switch. Remove two screws attaching switch and remove switch assembly.

Installation

Position switch and attach with two screws. Connect wires to switch terminals. Connect air line to opening in switch body. Build up air pressure in system and test switch as previously directed under "Serviceability Tests."

LOW AIR PRESSURE SWITCH OVERHAUL

Key numbers in text refer to figure 7.

Disassembly

1. Unscrew cover retainer (4) from body (12).
2. Remove cover (6) and lift out spring (11) and diaphragm assembly (3).

Cleaning and Inspection

1. Clean all metal parts in cleaning solvent. Examine diaphragm for signs of cracking, wear, or damage. Replace diaphragm if these conditions are found.
2. Inspect contact points for signs of pitting or wear. If pitting is not too severe, contacts may be reconditioned by filing with a fine distributor point file. If they cannot be reconditioned, they should be replaced.
3. Check spring for tension. If it has lost its tension, it should be replaced.

Assembly

Key numbers in text refer to figure 7.

1. Position diaphragm assembly (3) in body (12).
2. Place spring (11) so it will be on the upper diaphragm follower.

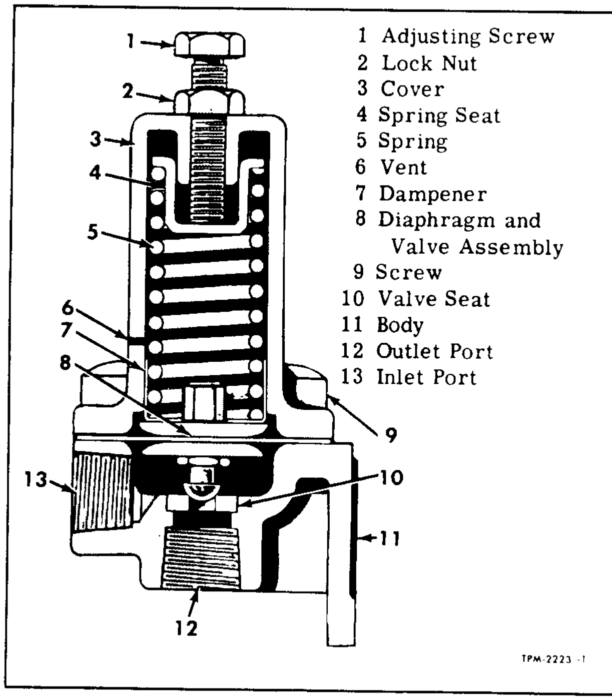


Figure 8—Pressure Regulator Valve

3. Place cover (6) over diaphragm (3). Install cover retainer (4) over cover (6) and thread into body (12). Tighten retainer firmly.
4. Test switch as previously directed under "Serviceability Tests." If pressure setting requires adjustment, add or remove shims (13) under spring.

PRESSURE REGULATING VALVE

Key numbers in text refer to figure 8.

Pressure regulating valve (fig. 8), mounted in compartment at left front corner of vehicle, is connected into the air line leading to the auxiliary air tank. The unit consists essentially of a valve diaphragm and spring, enclosed by a valve body and cover. Adjustment is made by means of the adjusting screw in the cover.

The pressure regulating valve serves two purposes in the air system. One purpose is to prevent air pressure from entering the auxiliary air system until pressure in main air brake system reaches 65 pounds. This provides a rapid build-up of pressure in the main air brake system for operation of brakes. When air pressure in main air brake system reaches 65 pounds, pressure regulating valve admits pressure into the auxiliary air system for operation of windshield wipers, air horn, and air pressure gauge, and supplies air pressure to the air suspension system. The second purpose of the pressure regulating valve is to pre-

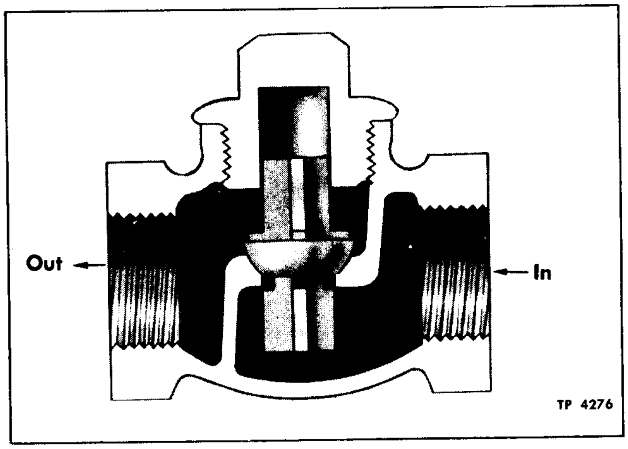


Figure 9—Auxiliary Air System Check Valve

vent lowering pressure below 65 pounds in main air brake system by operating windshield wipers or air horn, or by leakage in the auxiliary air system air lines.

SERVICEABILITY TESTS

1. Operating Test

Exhaust air pressure from system and install a test gauge in air brake system, preferably in the air line leading from air tank to the pressure regulating valve. Disconnect one of the windshield wiper air lines at the wiper motor. Build up pressure in system and note pressure when the valve permits air to pass to atmosphere. If pressure varies 5 pounds from the original setting (65 lbs.), the valve requires adjustment.

2. Leakage Test

No leakage is permissible at the vent hole in valve cover. Leakage at vent indicates a ruptured diaphragm.

With air line disconnected at bottom of valve and pressure in air brake system below the valve setting (65 lbs.), coat the bottom (outlet) opening of valve with soap suds. Leakage is caused by dirt on valve seat or by an excessively worn valve.

Leakage of a three-inch soap bubble in three seconds is permissible. If excessive leakage is found, remove valve and repair it as described later in this section.

ADJUSTING SET PRESSURE

The pressure at which the valve is unseated is controlled by the adjusting screw (1). Setting may be increased or decreased by turning screw.

1. Back off lock nut (2); then turn screw (1) clockwise to increase pressure, or counterclockwise to decrease pressure.
2. Tighten lock nut (2) when correct adjustment is obtained.

PRESSURE REGULATING VALVE REPLACEMENT

Removal

1. Exhaust air from system and disconnect air lines.
2. Remove mounting bolts and remove valve assembly from vehicle.

Installation

1. Position valve assembly and install mounting bolts.
2. Connect air lines and test valve as previously directed under "Serviceability Tests."

PRESSURE REGULATING VALVE OVERHAUL

Disassembly

1. Remove four screws (9) attaching cover (3) to body (11) and remove cover.
2. Remove spring (5), spring seat (4), and dampener (7) from cover.
3. Lift diaphragm and valve assembly (7) off body.

Inspection

1. Clean all parts thoroughly, using a suitable cleaning solvent. Wipe or blow parts dry.
2. Examine diaphragm for cracks or wear. If either the valve or diaphragm are worn or damaged, a new diaphragm and valve assembly should be installed.
3. Inspect valve seat in body. If seat is pitted, scratched, or chipped, it should be replaced.

Assembly

1. Place diaphragm and valve assembly (8) on body, with valve seated in valve seat in body. Install spring seat (4), spring (5), and dampener (7) in cover (3), and position cover on body (11).
3. Install four screws (9) through cover and diaphragm into body and tighten firmly.
4. Adjust set pressure as previously directed under "Adjusting Set Pressure."

AUXILIARY AIR SYSTEM CHECK VALVE

Auxiliary air system check valve (fig. 9), consisting of a valve body, valve, and valve cap, is connected into air lines at pressure regulating valve. This valve is a one-way valve, permitting air pressure to flow through it in one direction only. Check valve prevents air pressure flowing into the auxiliary air system without passing through the pressure regulating valve; however, it permits air pressure in the auxiliary air system to return to the main air brake system when pressure

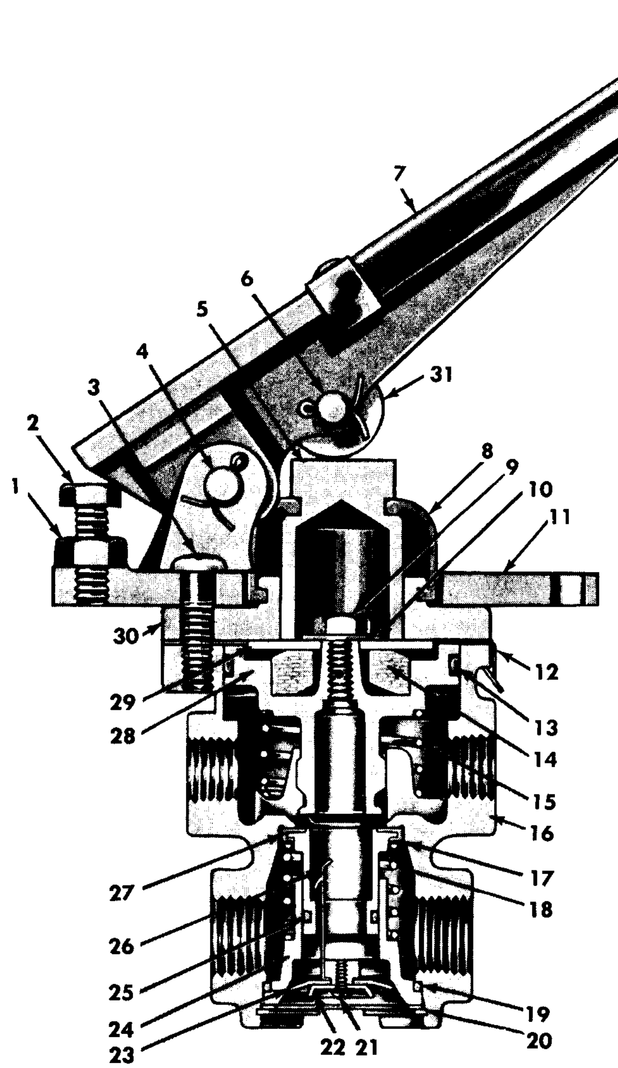


Figure 10—Brake Application Valve

in the main air brake system is reduced. Whenever check valve is removed it is essential that it be reinstalled to permit air flow in direction indicated by arrow on valve body. Mount check valve with valve cap at top.

BRAKE APPLICATION VALVE

DESCRIPTION

The brake application valve is mounted below coach floor in an upright position (fig. 10). Valve is attached to a mounting plate which is bolted to coach floor. The brake treadle is also mounted on the mounting plate and treadle roller contacts valve plunger. Movement of the treadle controls movement of an inlet valve and exhaust valve which in turn control air pressure being delivered to or released from the brake chambers. To fully apply brakes, the treadle must be fully depressed, whereas, when treadle is only partially depressed, correspondingly less braking force is developed. In other words, the farther driver depresses treadle, the greater air pressure delivered to the brake chambers and the more effective brake application. Brake valve is set up to graduate between 5 and 75 psi. First three degrees of brake treadle travel permits valve to deliver 5 psi, and the next 17 degrees of travel is the graduating range (5 to 75 psi). With any treadle movement beyond the first 20 degrees of travel, valve will deliver full reservoir pressure.

OPERATION (Fig. 10)

Application

When the brake treadle is depressed, force is exerted on the plunger, rubber graduating spring, and piston. The piston moves down and its stem,

AIR BRAKES

which is the exhaust seat, closes exhaust. As exhaust closes, the inlet valve moves off its seat. Air pressure from the reservoir then flows past the inlet valve and out delivery ports, applying the brakes.

Holding

When air pressure in cavity below the piston and air pressure being delivered to the brakes equals mechanical force on top of the piston, the piston lifts and inlet valve closes, cutting off any further flow of air from supply line through the valve. The exhaust remains closed preventing any escape of air through exhaust port. When the piston is pressed down all the way, the inlet port remains open and full reservoir pressure is delivered to the brakes.

Release

When treadle application is released and mechanical force is removed from top of piston, air pressure beneath the piston is then greater and the piston lifts, opening the exhaust in the valve. Air below piston and in the delivery lines is then exhausted through the exhaust port.

PREVENTIVE MAINTENANCE

After Each 5,000 Miles

1. Lubricate treadle roller and roller pin. Also hinge pin on treadle. Use engine oil for lubrication.
2. Lift boot away from plunger or mounting plate and put a few drops of light engine oil between plunger and mounting plate. Be careful not to get oil on rubber spring when applying to plunger. Oil will cause deterioration of the rubber spring.

After Each 50,000 Miles

It is recommended that inlet and exhaust valve, exhaust diaphragm, grommets, and rubber graduating spring be replaced if they show signs of wear or deterioration.

After 100,000 Miles

Disassemble brake application valve, clean and inspect all parts. Install new parts where parts are found to be worn or damaged.

BRAKE APPLICATION VALVE SERVICEABILITY TESTS

1. Operating Tests

Check delivery pressure of the brake valve using an accurate test gauge connected into one of the air lines leading to brake chambers. Depress brake treadle to several positions between fully released and fully applied positions, and check delivered pressure on test gauge to see that it varies proportionately with movement of the treadle. When treadle is fully applied, reading on test gauge should be approximately that of full reservoir pressure. The reading on the test gauge should fall off to zero when application is released.

2. Leakage Tests

a. With the valve fully released, check exhaust port for leakage. No leakage is permissible.

b. Make and hold a high pressure application. Coat exhaust port and top of valve with soap suds. No leakage is permissible.

c. Leakage evidenced by these tests may be due to a worn or deteriorated exhaust valve or leaking piston seals.

BRAKE APPLICATION VALVE REPLACEMENT

NOTE: The brake application valve can be removed from coach separately or with the brake treadle.

Removal

1. Block or hold vehicle by means other than air brakes.
2. Open drain cocks and exhaust air pressure from the air brake system.
3. Disconnect air lines from the brake application valve.
4. Remove two bolts and lock washers attaching application valve adapter plate to treadle mounting plate. Remove application valve. If valve and treadle are to be removed as an assembly, remove three screws attaching treadle mounting plate to coach floor. Remove valve and treadle.

Installation

1. If application valve was removed from brake treadle mounting plate, attach valve to mounting plate with two bolts and lock washers. If valve and brake treadle were removed from coach as an assembly, position the assembly on coach floor and install three attaching screws.
2. Connect air lines to valve ports. When installing connector fittings in valve, use sealing compound on fitting threads. KEEP SEALING COMPOUND OFF FIRST TWO THREADS OF FITTINGS. Tighten connections firmly. If removed, replace pipe plugs in remaining ports.
3. Build up air pressure in system and test application valve as previously directed under "Serviceability Tests."

APPLICATION VALVE OVERHAUL

NOTE: Inlet and exhaust valve components can be serviced without removing valve assembly from vehicle (steps 6 through 9 following).

Disassembly

Key numbers in text refer to figure 10.

1. If brake valve and treadle were removed from coach as an assembly, remove two bolts and lock washers attaching valve adapter plate to treadle mounting plate. Remove valve assembly.

2. Remove all dirt from outside of valve assembly.

3. Remove three screws attaching adapter plate (30) to valve body (16). Remove adapter plate (30), boot (8), and plunger (5). Separate these parts.

4. Depress piston assembly and hold down while removing piston retainer (12).

5. Remove piston assembly and return spring (15) from valve body. Remove grommet (13) from piston (28).

NOTE: Piston (28), rubber spring (14), spring retainer (29), and cap screw (9) are serviced only as an assembly.

6. Depress and hold prongs of the inlet and exhaust valve assembly retaining ring with pliers, and remove retaining ring (20). Remove inlet and exhaust valve assembly (27).

7. Remove inlet-exhaust valve body grommet (19). Remove machine screw (21), diaphragm washer (22), and diaphragm (23) from inlet-exhaust valve body seat (24).

8. Depress and hold inlet-exhaust valve (27), and remove preload spring (26).

9. Slide inlet-exhaust valve (27) out of inlet-exhaust valve body seat (24). Remove spring (18), spring seat washer (17), and grommet (25) from inlet-exhaust valve.

10. Remove cotter pin; then using hammer and small punch, tap out brake treadle attaching pin (4). Remove treadle from mounting plate.

11. Remove roller by removing cotter pin and tapping roller pin (6) out with hammer and small punch. Remove roller.

Cleaning and Inspection

Wash all metal parts in cleaning solvent and dry thoroughly. Discard all grommets and exhaust diaphragm. Obtain new parts for reassembly of application valve.

1. Treadle Assembly. Check fit of treadle pin in treadle and mounting plate. Pin must be a neat, free fit. Inspect treadle roller for fit on roller pin, also for flat spots. Roller must be a free rolling fit on pin. If excessive wear is found, or if the roller has any flat spots, pin, roller, or both must be replaced.

2. Plunger and Adapter Plate. Check fit of plunger in adapter plate. Replace plunger if necessary. Check adapter plate for cracks or other damage. Replace if necessary.

3. Piston Assembly. Inspect exhaust seat at bottom of piston stem. Remove slightly worn spots by lapping on a piece of crocus cloth on a flat surface. Inspect outside surfaces of piston which contact bores in valve body for scratches, nicks, or out-of-round condition. Replace piston assembly if badly worn or damaged.

4. Springs. Inspect piston return spring and inlet-exhaust valve spring for evidence of corrosion which would weaken the spring. Check springs for free length, compressed length, distortion or collapsed coils. Replace if necessary.

5. Valve Body. Inspect the body for scores and excessive wear where piston grommets make contact with body. If excessive wear or grooves are found, the body should be replaced. Inspect small bleed hole leading to brake chamber port in body to be sure it is open and not obstructed. Inspect inlet valve seat for roughness or corrosion. If damage is evident, replace body.

6. Inlet-Exhaust Valve Assembly. Inspect rubber seal at top of inlet-exhaust valve. Examine outside diameter of valve and inside diameter of valve body for excessive wear or scoring. Inlet valve must slide freely in valve body. If any damage is evident on either part, replace with new part.

Assembly

Key numbers in text refer to figure 10.

1. Prior to assembly, apply a light coat of Lubriplate or equivalent to the piston, valve bores, and grommets.

2. Mount body (16) in a vise with large opening facing up. Use radius blocks or soft jaws to prevent crushing or marring of body.

3. Install piston grommet (13) on piston. Place piston return spring (15) in valve body. Install piston assembly in valve body. Take precautions not to damage piston grommet during installation.

4. Install piston retainer (12). Be sure prongs snap over groove in valve body.

5. Position inlet valve preload spring (26), exhaust diaphragm (23), and diaphragm washer (22) (lips pointing out) in inlet-exhaust valve body, and attach with machine screw and lock washer assembly (21). Tighten screw to 15-25 inch-pounds.

6. Install grommet (25) and position spring seat washer (17) on inlet-exhaust valve (27).

7. Position valve spring (18) on spring seat of inlet-exhaust valve body (24). Install inlet-exhaust valve into the valve body, by depressing the spring until the preload spring snaps onto the counterbore ledge of the inlet-exhaust valve.

8. Install large grommet (19) on inlet-exhaust valve body seat.

9. Place inlet and exhaust valve assembly into valve body, and press in to install retaining ring (20). Make sure retaining ring snaps into body grooves, locking in the valve assembly.

10. Attach the adapter plate (30) to valve body with three cap screws (3) and lock washers.

11. Replace plunger (5) inside adapter plate,

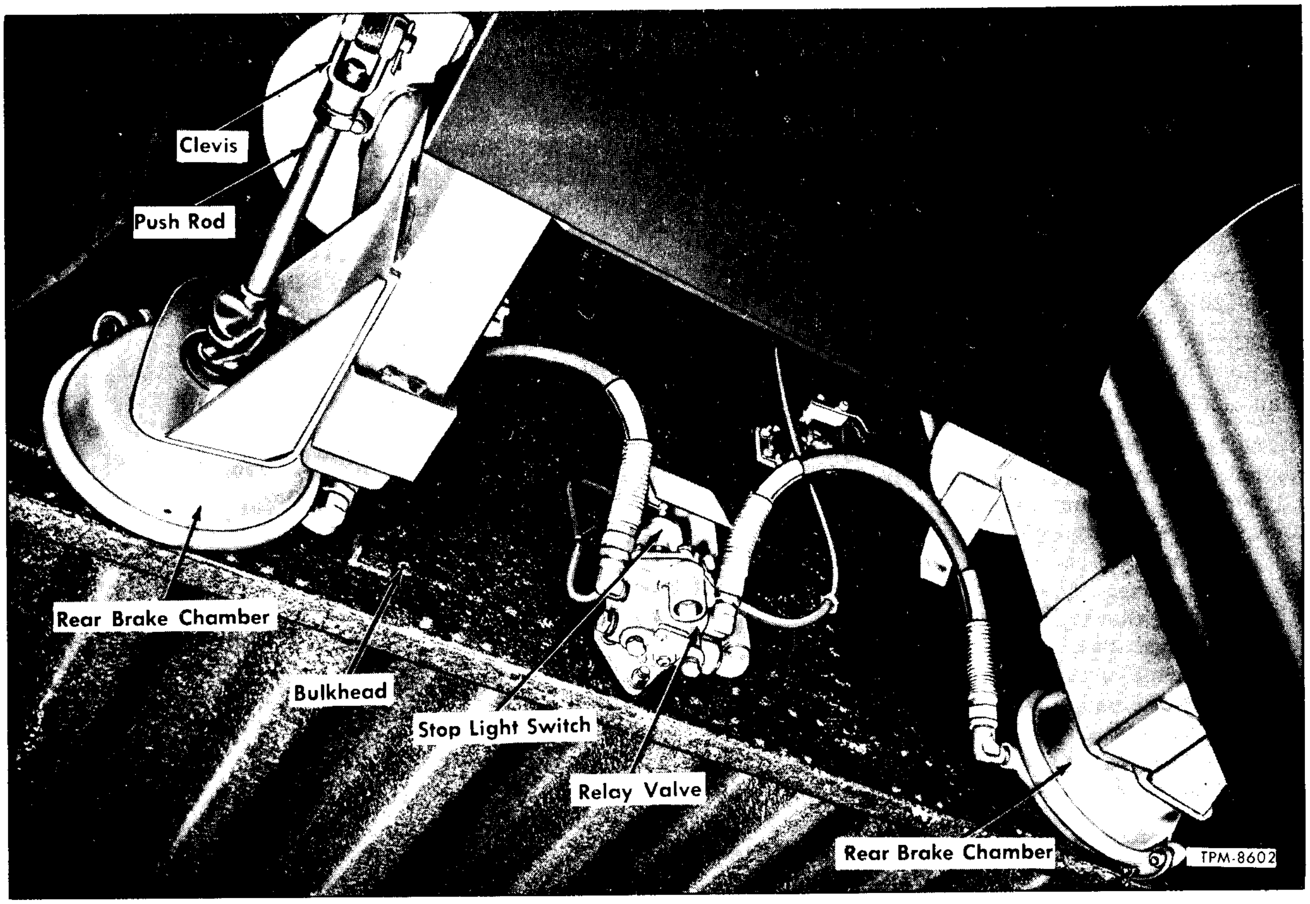


Figure 11—Rear Brake Relay Valve Installed

and place rubber boot (8) around plunger.

12. Place roller (31) in position in treadle (7), and tap roller pin (6) in place. Install new cotter pin.

13. Position treadle (7) on mounting plate, install treadle pin (4) and attach with new cotter pin.

REAR BRAKE RELAY VALVE

Relay valve is mounted on bulkhead above rear axle (fig. 11). Rear brake application and release is made through the relay valve. The supply line from the air tank connects to a cavity in lower part of valve, providing a source of high pressure air close to rear brake chambers at all times. The relay valve and brake application valve are interconnected by a smaller air line, which delivers air pressure to top of the relay valve diaphragm to actuate the valve. In addition to providing more rapid application of rear brakes, the relay valve also fulfills the function of a quick release valve, permitting rapid release of air pressure from rear brake chambers.

RELAY VALVE OPERATION (Fig. 12)

Operation of the relay valve is controlled by air pressure delivered to it by the brake application valve. Air pressure from brake application valve enters a cavity above the rubberized diaphragm. Since this cavity is comparatively small and therefore subject to quick changes in air pressure, action of the valve in changing its delivered pressures is very rapid.

1. Applying

As compressed air from the application valve enters cavity at top, air pressure pushes down diaphragm sealing off exhaust cavity. Further movement of diaphragm center forces down diaphragm guide and inlet valve. As inlet valve is forced off seat, air from dry tank flows through valve into cavity below diaphragm and on out to brake chambers.

2. Holding

As soon as air pressure above the diaphragm stops increasing, pressure below the diaphragm balances by means of a by-pass port in valve cover. This balance of pressures on each side of diaphragm removes pressure from diaphragm guide and inlet valve. Valve spring then closes in-

let valve. Air pressure above the diaphragm maintains the seal between outer edge of diaphragm and rim of exhaust cavity. The valve is now in holding position. Brake chamber pressure is the same as application valve pressure. An increase in pressure at application valve will immediately result in the same pressure increase in brake chambers.

3. Releasing

When application valve pressure above diaphragm is reduced, brake chamber pressure (below diaphragm) forces diaphragm upward. As diaphragm uncovers rim of exhaust cavity, air is exhausted until pressures again balance. If all pressure is removed from application valve treadle, the relay valve will release all air from brake chambers fully releasing brakes.

RELAY VALVE SERVICEABILITY TESTS

1. Operating Test

With air brake system fully charged, apply brakes and make sure rear wheel brakes apply promptly. Release brakes and make sure air pressure is quickly exhausted from exhaust port of the relay valve.

2. Leakage Tests

a. With brakes released, cover exhaust port with soap suds. Leakage in excess of a 1-inch bubble in one second is not permissible. Leakage is caused by inlet valve not seating properly.

b. With brakes applied, cover exhaust port with soap suds. Leakage in excess of a 1-inch bubble in one second is not permissible. Leakage is caused by defective diaphragm or seat.

c. If leakage is caused by diaphragm, both diaphragm and diaphragm seat should be wiped clean with gasoline. If leakage is caused by inlet valve, valve and seat must be cleaned, or replaced with new parts.

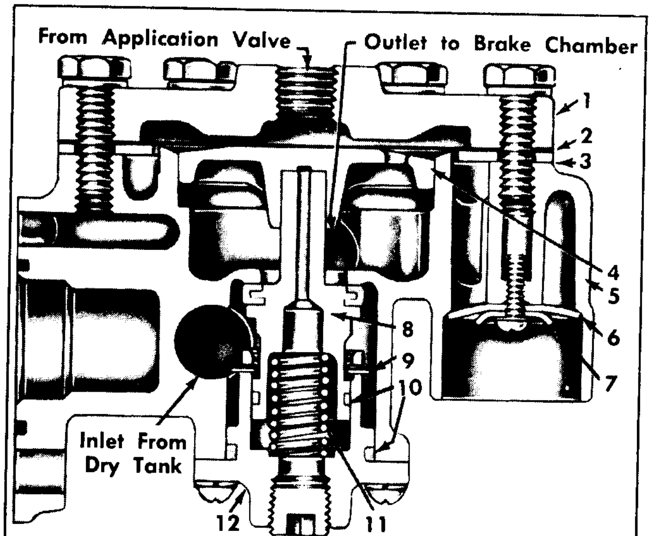
RELAY VALVE REPLACEMENT

Removal

Exhaust air pressure from system. Disconnect air lines from valve, remove stop light wires and mounting bolts; then remove valve assembly from vehicle. Remove stop light switch and tee fitting from top of valve.

Installation

Install tee fitting and stop light switch on top of valve. Mount valve on bulkhead and tighten mounting bolts firmly. Connect air lines to valve, and wires to stop light switch. Build up air pressure in system; then test valve as previously directed under "Serviceability Tests."



1 Valve Cover
2 Valve Diaphragm
3 Diaphragm Ring
4 Diaphragm Guide
5 Body
6 Exhaust Diaphragm
7 Diaphragm Washer
8 Inlet Valve
9 Retaining Ring
10 O-ring
11 Valve Spring
12 Guide Cap TPM-6914

Figure 12—Rear Brake Relay Valve

RELAY VALVE OVERHAUL

Disassembly

Key numbers in text refer to figure 12.

1. Mark valve cover (1), diaphragm ring (3), and valve body (5), so parts can be reassembled in same position. Remove six cap screws and lock washers attaching valve cover (1) to valve body (5). Remove cover (1), diaphragm (2), diaphragm ring (3), and diaphragm guide (4) from valve body (5).

2. Remove four screws and lock washers attaching guide cap (12) to bottom of valve body (5). Remove valve cap (12) and inlet valve assembly (8). Remove retaining ring (9) and separate inlet valve (8), valve spring (11), and guide cap (12). Remove and discard O-rings (10).

3. Remove screw and lock washer holding exhaust diaphragm (6) in place. Remove diaphragm washer (7) and exhaust diaphragm (6).

Inspection

1. Thoroughly clean all parts in suitable cleaning solvent.

2. Examine diaphragms for cracking, stretching, or deterioration. Replace if not in good condition.

3. Inspect diaphragm seat at top of valve body. Seat must be smooth and free from scratches or corrosion. If only slightly scratched or corroded, seat may be repaired by lapping on a flat surface

AIR BRAKES

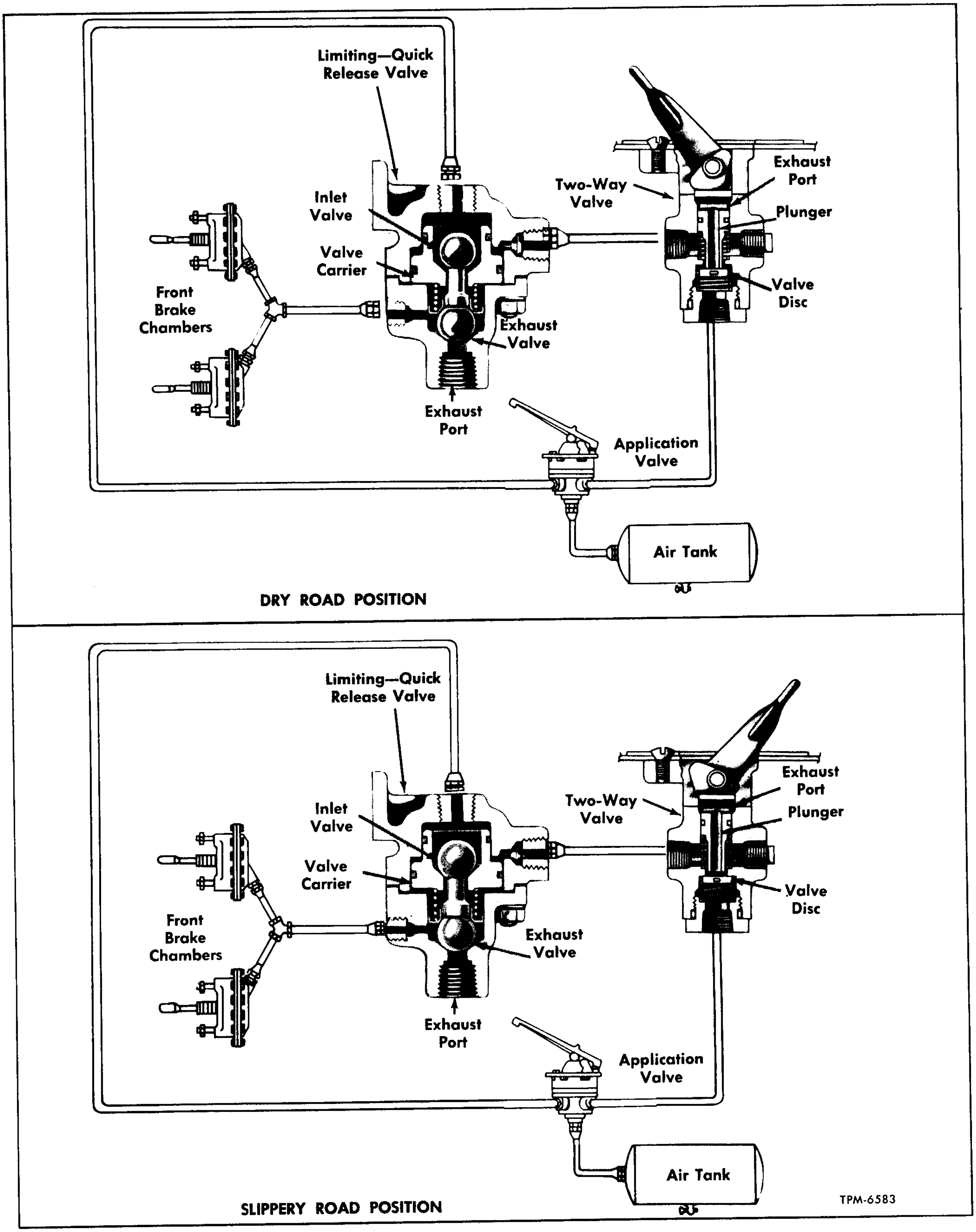
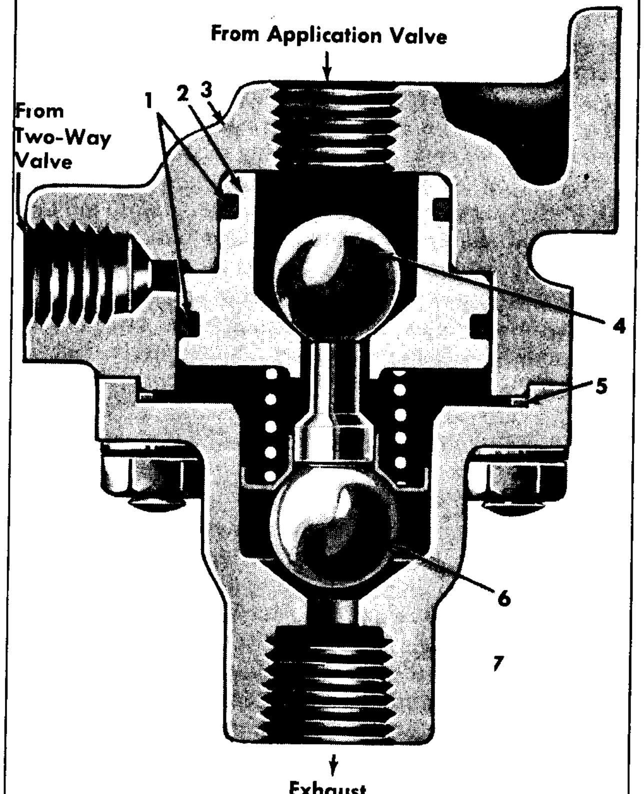


Figure 13—Front Brake Limiting and Two-Way Control Valve Operation



1 O-rings
2 Valve Piston
3 Valve Body
4 Inlet Valve
5 O-ring
6 Exhaust Valve
7 Valve Cover

TPM-8563

Figure 14—Front Brake Limiting and Quick Release Valve

covered with fine aluminum oxide abrasive cloth.

4. Examine inlet valve and inlet valve seat. Rubber seating surface on inlet valve is bonded in place. If valve or seat are scratched or worn, replace with new parts. Replace weak or damaged valve spring.

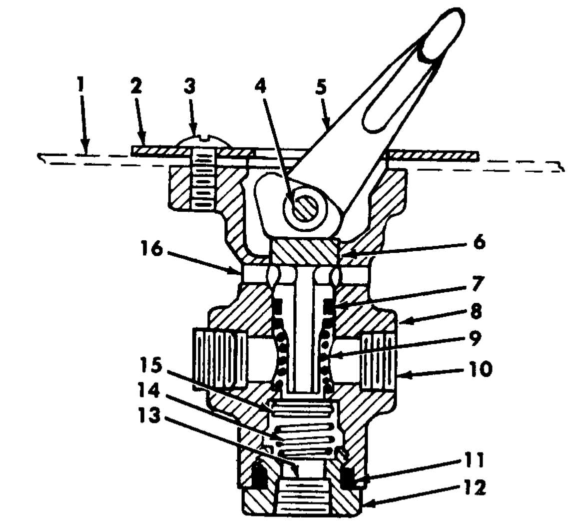
5. Diaphragm guide bore in valve body, and inlet valve bore in guide cap should be smooth. If badly damaged, replace parts.

Assembly

Key numbers in text refer to figure 12.

1. Place new O-ring (10) on guide cap (12) and on inlet valve (8). Apply thin coat of Lubriplate or equivalent inside guide cap, and body bores in contact with cap and with diaphragm guide. Insert spring (11) and O-ring end of inlet valve (8) in guide cap (12) bore. Force inlet valve (8) down into guide cap (12). Place retaining ring (9) in cap groove and snap around narrow neck of inlet valve (8).

2. Insert inlet valve and cap assembly through bottom of relay valve body (5). Attach cap to body



1 Panel
2 Dial
3 Screw
4 Lever Pin
5 Control Lever
6 Valve Plunger
7 O-Ring
8 Valve Body
9 Valve Plunger Return Spring
10 Outlet to Limiting Valve
11 O-Ring
12 Cap Nut
13 Inlet From Application Valve
14 Valve Spring
15 Valve Disc
16 Exhaust

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Figure 15—Two-Way Control Valve (Also I.C.C. Valve)

with four screws and lock washers. Tighten firmly.

3. Place diaphragm guide (4) over stem of inlet valve (8). Position diaphragm ring (3) on body aligning match marks. Place diaphragm (2) on ring, and align by-pass holes. Install cover (1) aligning match marks. Parts should be aligned, without obstructing by-pass port. Install six cap screws and lock washers and tighten to 50-70 inch-pounds torque.

4. Insert exhaust diaphragm (6) and diaphragm washer (7) (cupped away from diaphragm) in exhaust port. Install screw and lock washer and tighten firmly.

FRONT BRAKE LIMITING VALVE AND TWO-WAY CONTROL VALVE

A combination front brake limiting and quick-release valve (fig. 14) and a two-way control valve (fig. 15), are used in combination on some vehicles as shown in figure 13. This combination delivers full air pressure to front brakes when on dry roads, or at option of the driver, limits front brake air pressure by half when on slippery roads.

The two-way control valve is mounted on dash within easy reach of the driver. The limiting quick-

release valve is mounted beneath coach floor near front axle. One air line from brake application valve is connected to inlet port of the two-way valve and another line connects to the brake valve port at top of limiting quick release valve (fig. 13). Another air line connects side delivery port of the control valve to port opposite the mounting pad of the limiting valve. The two other side ports of the limiting valve are connected to front brake chambers.

OPERATION

1. Dry Roads (Top View, Fig. 13)

a. When handle of the two-way valve is placed in "DRY ROAD" position, hollow plunger of the valve is depressed and contacts valve disc, unseating valve. In this position, air passage through hollow plunger is closed and air pressure from brake application valve has free passage through two-way valve to front port of the limiting quick release valve.

b. When coach brakes are applied, air pressure from brake application valve enters limiting quick release valve at top. This air pressure, acting on upper inner surface of the valve piston, forces piston down until exhaust valve contacts valve seat in the valve cover, closing exhaust port. The piston still continues to move downward, partially opening the inlet valve.

c. At the same time, pressure from the application valve passes through the two-way valve as explained in (a) above, and enters limiting quick release valve at the side. With valve piston already partially depressed, air pressure coming from the two-way valve acts on larger outer surface of the valve piston and forces piston down still further to limit of travel. This action moves piston fully away from the inlet valve, permitting full application valve pressure to be delivered to front brake chambers.

2. Slippery Roads (Bottom View, Fig. 13)

a. When handle of the two-way valve is placed in "SLIPPERY ROAD" position, hollow plunger is raised by the plunger spring and valve disc is held closed by the valve spring. Any air pressure in line connecting limiting quick release valve and the two-way valve will be exhausted through the hollow plunger and exhaust port of two-way valve.

b. When brake application valve is applied with the two-way valve in slippery road position, air pressure from brake application valve is stopped at valve disc of the two-way valve and does not enter side port of the limiting quick release valve. At the same time, however, air pressure from the application valve enters limiting quick release valve at the top. This pressure, acting on upper inner surface of the valve piston, forces piston down until the exhaust valve closes exhaust port and partially opens the inlet valve. Air pressure passing by the inlet valve and building up in brake chambers is acting on lower surface of valve piston. The lower surface of valve piston is approximately twice as large as upper inner surface. Therefore, when pressure acting on lower surface of the piston is approximately one-half application valve delivery pressure, the valve piston moves up and closes the inlet valve, and exhaust valve will remain closed. The limiting quick release valve is then in a position where pressure in lower portion of valve and in brake chambers will be approximately one-half pressure being delivered to upper portion of valve by the application valve.

SERVICEABILITY TESTS

1. Operating Tests

a. Install an air pressure test gauge in brake application valve delivery line. Disconnect one front brake chamber line from port at side of limiting quick release valve and connect another test gauge to this port.

b. Place handle of the two-way valve in "DRY ROAD" position and apply brakes. Both test gauges should read the same. Place handle of the two-way valve in "SLIPPERY ROAD" position and apply brakes. The test gauge at limiting quick release valve should read approximately one-half amount shown on test gauge connected to the application valve delivery line.

2. Leakage Tests

a. Place handle of the two-way valve in "DRY ROAD" position and with brakes applied, coat exhaust ports of the two-way valve and limiting quick release valve with soap suds. Leakage at either port should not exceed a one-inch soap bubble in one second.

b. Place handle of the two-way valve in "SLIPPERY ROAD" position and with brakes applied, coat exhaust port of the two-way valve with soap suds. Leakage should not exceed a one-inch bubble in one second.

LIMITING AND QUICK RELEASE VALVE REPLACEMENT

Removal

1. Exhaust air pressure from the air system.

2. Disconnect all air lines from valve. Remove valve attaching screws and remove valve from support.

Installation

1. Position valve on support and install attaching screws. Tighten securely.

2. Connect air lines to valve, making sure

all connections are tight.

3. Build up air pressure in system to normal operating pressure; then test valve as previously described under "Serviceability Tests."

TWO-WAY CONTROL VALVE REPLACEMENT

Removal

1. Exhaust air pressure from the air system.

2. Disconnect all air lines from control valve; then remove control valve from front of dash by removing two screws and valve dial.

Installation

1. Install control valve at front of dash panel attaching with valve dial and two screws.

2. Connect all air lines to valve, making sure all connections are tight.

3. Build up air pressure in system to normal operating pressure; then test valve as previously described under "Serviceability Tests."

LIMITING AND QUICK RELEASE VALVE OVERHAUL (Fig. 14)

Disassembly

1. Remove nuts and lock washers from studs securing valve cover to valve body. Separate cover and body. Remove and discard O-ring seal.

2. Push valve piston with inlet and exhaust valve assembly out of valve body.

3. Remove O-rings from grooves in valve piston. Discard O-ring seals.

Cleaning, Inspection, and Repair

1. Wash all metal parts in cleaning solvent. Wipe or blow parts dry.

2. Examine body and cover for cracks or other damage.

3. Inspect exhaust valve seat in cover; if seat is nicked, chipped, or worn, replace cover. Remove slight scratches or scores from inner surface of body with crocus cloth.

4. If any part of the valve piston or inlet and exhaust valve assembly is scratched, nicked, chipped, worn, or damaged in any way, the complete assembly must be replaced.

Assembly

1. Install new O-ring seals in grooves in valve piston; then place valve assembly in body.

2. Place new O-ring seal in cover; then install cover on body, making sure valve guide enters bore in cover. Install nuts and lock washers on cover-to-body studs and tighten firmly.

3. After installing valve in vehicle, or using a test hook-up, test valve as previously directed under "Serviceability Tests."

TWO-WAY CONTROL VALVE OVERHAUL (Fig. 15)

Disassembly

1. Using a small drift, drive out fulcrum pin securing control lever in valve body and remove lever.

2. Remove cap nut, O-ring, valve spring, and valve from bottom of body. Discard O-ring.

3. Push against bottom of valve plunger to remove plunger from top of body. Remove plunger return spring from body. Remove O-ring from plunger and discard.

Cleaning and Inspection

1. Wash all metal parts in cleaning solvent. Wipe or blow parts dry.

2. Carefully examine small end of plunger which contacts valve; if any roughness or damage is evident, replace plunger.

3. Inspect valve seat in body; if seat shows wear or damage, replace body.

4. Replace valve disc if any wear or damage is evident. Replace valve spring if weakened by corrosion.

Assembly

1. Install new O-ring seal in groove of plunger and on cap nut.

2. Coat plunger, pin, and cam with Lubriplate or equivalent.

3. Place spring on small end of plunger, and install plunger and spring in top of body.

4. Install control lever in body, and secure with fulcrum pin. Stake pin in place.

5. Turn body bottom side up and install valve disc, valve spring, and cap nut, being sure new O-ring is in place on cap nut. Tighten cap nut firmly.

6. After installing valve in vehicle, or using a test hook-up, test valve as previously directed under "Serviceability Tests."

AUXILIARY BRAKE CONTROL (I.C.C.) BRAKE VALVE

OPERATION

I.C.C. (Interstate Commerce Commission) brake valve is provided as an emergency method for applying the air brakes on rear axle. Valve is mounted at right side of driver. Valve control lever should remain in "OFF" position at all times during normal operation. When lever is moved to "ON" position, full air pressure in system is applied to brakes on rear axle only.

IMPORTANT: Valve should be tested at regular intervals to make sure it is operating properly.

The I.C.C. valve and the two-way control valve shown in figure 15 are identical except for wording on dials. The following key numbers refer to figure

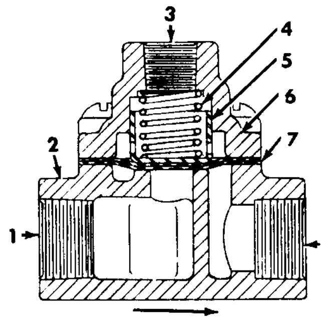


Figure 16—Air Pressure Cut-Off Valve

15. Valve is in "OFF" position, with plunger (6) raised and valve disc (15) against valve seat in body. Air supply line from front air tank is connected to inlet port (13) in cap nut (12). Outlet line to rear brake relay valve is connected to outlet port (10).

When control lever (5) is moved to "ON" position, cam on lever forces plunger down. Lower end of plunger seats against valve disc (15) closing exhaust passage through plunger, and forcing valve disc off seat in body. This permits full air pressure to flow past valve disc into line leading to rear brake relay valve. With full air pressure applied to relay valve, relay valve delivers full pressure to brakes on rear axle. At the same time, air pressure being delivered to relay valve enters top of air pressure cut-off valve, cutting off flow of air pressure to brake application valve and auxiliary air system. Refer to "Air Pressure Cut-off Valve" later.

When valve control lever is returned to "OFF" position, plunger spring raises plunger, permitting valve spring to seat valve disc against seat in body, shutting off flow of air pressure. Air pressure which has been let into line leading to relay valve is exhausted through the hollow plunger, permitting relay valve to exhaust air pressure from rear brakes.

I.C.C. BRAKE VALVE REPLACEMENT

Removal

1. Exhaust air pressure from air brake system.
2. Disconnect air lines from valve ports.
3. Remove two screws attaching valve to support. Remove valve assembly and dial.

Installation

1. Position valve assembly on support. Install dial and two screws. Tighten screws firmly.
2. Connect air lines to valve, making sure all connections are tight.
3. Build up air pressure in system to normal operating pressure.

NOTE: Refer to "Two-Way Valve Overhaul" earlier in this section for information on disassembly, inspection, and assembly of the I.C.C. valve. Procedures are the same.

AIR PRESSURE CUT-OFF VALVE

Air pressure cut-off valve (fig. 16) is installed in air line from front air tank supplying air pressure to brake application valve and auxiliary air system, and is also connected to the outlet side of the I.C.C. brake valve. Normally, air pressure from air tank lifts diaphragm in cut-off valve and flows through valve to brake application valve and auxiliary air system. When I.C.C. brake valve control lever is moved to "ON" position, air pressure from I.C.C. brake valve, flowing to rear brake relay valve, at the same time enters cut-off valve above the diaphragm. Combined force of air pressure and spring above diaphragm overcomes force of air pressure below diaphragm and forces diaphragm down, cutting off flow of air pressure to application valve and auxiliary air system.

Air cut-off valve is located in tool and inspection compartment at right of brake application valve. Arrows on top of valve body indicate normal direction of air flow through the valve.

AIR PRESSURE CUT-OFF VALVE REPLACEMENT

Removal

1. Exhaust air pressure from the air system.
2. Disconnect all air lines from valve and remove valve.

Installation

1. Connect all air lines to the valve, making sure all connections are tight. Be sure arrows on top of valve cover are pointed toward brake application valve.
2. Build up air pressure in the system to normal operating pressure.

AIR PRESSURE CUT-OFF VALVE OVERHAUL

Disassembly (Fig. 16)

Remove four screws attaching cover to body. Remove cover, spring, spring seat, and diaphragms.

Cleaning and Inspection (Fig. 16)

Clean all parts thoroughly. Examine diaphragms; if any signs of cracking or deterioration are evident, replace with new diaphragms. Make sure diaphragm seat in body is clean and smooth. Bore in cover must be clean and smooth to permit

free movement of spring seat. If spring has been weakened by rust or corrosion, replace with new spring.

Assembly (Fig. 16)

Lubricate bore in cover contacted by spring seat with thin coat of molybdenum lubricant. Place diaphragms on body. Place spring and spring seat in cover and position cover on diaphragms and body. Install four screws and tighten securely.

DOUBLE CHECK VALVE

Double check valve (fig. 17) is installed in air line between I.C.C. valve and brake application valve. Valve is located in tool compartment near auxiliary air tank. Lines from check valve lead to application valve, to I.C.C. valve, and to rear brake relay valve.

When I.C.C. brake valve lever is placed in "ON" position, compressed air from front (dry) tank passes through I.C.C. valve and enters double check valve. The air pressure forces shuttle valve against inlet port from application valve. Air passes on through outlet port into rear brake relay valve and applies rear brakes only.

When I.C.C. brake valve lever is in "OFF" position and foot brake is applied, air pressure forces shuttle valve against inlet port. Compressed air then flows through outlet port to rear brake relay valve and applies rear brakes. Air from application valve also applies front brakes.

DOUBLE CHECK VALVE REPLACEMENT

Removal

1. Exhaust air pressure from the air system.
2. Remove nuts and washers attaching check valve to mounting stud.
3. Disconnect all air lines from the valve and remove valve.

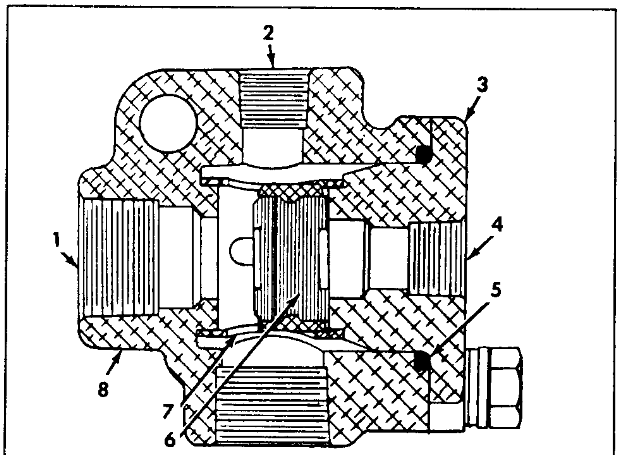
Installation

1. Mount check valve assembly on mounting stud and install nuts and washers. Tighten firmly.
2. Connect all air lines to the valve ports, making sure all connections are tight.
3. Build up air pressure in the system to normal operating pressure.

DOUBLE CHECK VALVE OVERHAUL

Disassembly

1. Remove two cap screws, lock washers, and plain washers attaching valve cover to body. Separate cover from body.
2. Remove shuttle valve and valve guide from valve body.



1 From I.C.C. Valve
2 To Rear Brake Relay Valve
3 Cover
4 From Application Valve
5 Grommet
6 Shuttle Valve
7 Valve Guide
8 Body

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Figure 17—Double Check Valve

3. Remove grommet from valve cap. Discard grommet.

Cleaning and Inspection

1. Clean parts in cleaning solvent. Wipe or blow parts dry.
2. Inspect parts for corrosion, wear, or other damage. Replace damaged parts.
3. Check shuttle valve. Valve should slide freely in guide.

Assembly

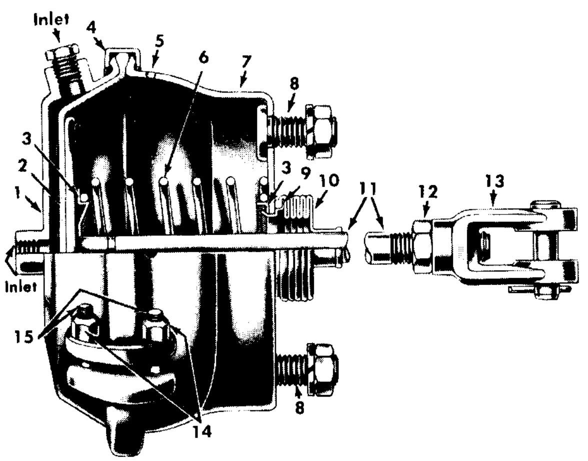
1. Install shuttle valve and guide in valve body.
2. Position a new grommet on valve cover.
3. Place cover on body and install two cap screws, lr.k washers, and plain washers. Tighten screws firmly.

AIR LINE TEST VALVE

An air line test valve installed in air line on engine compartment bulkhead (fig. 2), is used primarily to keep the air suspension system inflated during long periods while coach is standing still. However, valve can be used to check air system pressure, by using an ordinary tire gauge.

BRAKE CHAMBERS

Each front brake chamber is mounted at wheel as shown in figure 20. Rear brake chambers are mounted at rear end of rear suspension support (fig. 21). Front brake chambers are connected to air system through the application valve. Rear



1 Pressure Plate	9 Boot Retainer
2 Diaphragm	10 Rubber Boot
3 Spring Guide	11 Push Rod
4 Clamp Ring	12 Lock Nut
5 Breather	13 Push Rod Yoke
6 Return Spring	14 Lock Nuts
7 Non-Pressure Plate	15 Clamp Ring Bolts
8 Mounting Studs	

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Figure 18—Brake Chamber

brake chambers are connected through brake relay valve.

The purpose of brake chambers is to convert the energy of compressed air into the mechanical force and motion necessary to operate the mechanical brake assembly at each wheel. Brake chambers are linked, through slack adjusters, to brake operating cams. As air pressure extends push rod, slack adjuster acts as a lever and turns cam, expanding brake shoes in drum.

A rubber boot, shown in figure 18, keeps dirt and water out of brake chamber. Four equally spaced 1/4" holes near clamping ring, provide for breathing on non-pressure side of diaphragm.

BRAKE CHAMBER SERVICEABILITY TESTS

1. Operating Test

Apply brakes. Brake chamber push rods should move out promptly without binding. Release brakes. Rods should return to released position promptly without binding.

2. Leakage Tests

a. Fully apply brakes. Coat edges of the clamping ring with soap suds to check for leakage. No leakage is permissible. If leakage is found, tighten clamp ring bolts evenly but only sufficiently to prevent leakage, otherwise the diaphragm will be distorted resulting in premature failure.

b. Fully apply brakes. Check for leakage through the diaphragm by applying soap suds to breather holes and to push rod boot. No leakage is permissible. If soap bubbles indicate a leak, replace diaphragm.

BRAKE CHAMBER REPLACEMENT

Removal

1. Disconnect hose from brake chamber as follows: Hold hose union nut with a wrench while turning connector out of fitting or elbow in brake chamber. If new brake chamber is to be installed, remove connector fitting or elbow for installation on replacement unit.

2. Remove cotter pin and clevis pin; then remove push rod yoke from slack adjuster.

3. Remove nuts and lock washers from two brake chamber mounting studs; then remove brake chamber assembly from bracket.

Installation

1. Position brake chamber on bracket, with mounting studs through holes in bracket. Install lock washer and nut on each stud and tighten firmly.

2. Install elbow or connector fitting in brake chamber.

3. Connect hose as follows: Thread connector into elbow or fitting and tighten firmly while holding hose union nut with a wrench.

4. Connect brake chamber push rod yoke to slack adjuster. Adjust brakes as previously directed under "Brake Adjustments." Apply brakes and make sure push rods are correct length. Angle formed by push rod and slack adjuster should form an angle of more than 90 degrees, and should still be slightly greater than 90 degrees with brakes applied. In other words, the slack adjuster should not go "over center" when brakes are applied. If necessary, adjust push rod length by turning yoke onto or off push rod. Push rod must not extend through yoke far enough to interfere with slack adjuster. Test brake chamber as previously directed under "Serviceability Tests."

BRAKE CHAMBER OVERHAUL

Disassembly (Fig. 18)

1. Before disassembling brake chamber, mark non-pressure plate, pressure plate, and clamp ring. Parts may then be reassembled in same relative position. This will eliminate possibility of installation interference when brake chamber is reinstalled.

2. Remove yoke and lock nut from push rod. Remove nuts from two clamp ring bolts and remove bolts. Use caution when separating plates because of tension on return spring. Spread clamp ring and remove from plates; then remove pressure plate and diaphragm.

3. Remove push rod, spring guide, and spring from non-pressure plate. Remove boot from retainer.

Cleaning and Inspection

1. Clean all metal parts thoroughly, using a suitable cleaning solvent.

2. Examine diaphragm. Replace with new part if any signs of damage or deterioration are evident. Diaphragms should be replaced every 50,000 miles, or at least once a year.

3. Examine push rod, spring, and spring guide. Replace with new parts if weak or broken. Replacement spring should have the same tension as spring in opposite brake chamber. Mismatched springs will result in unbalanced braking.

4. Inspect pressure plate and non-pressure plate. Clamping flanges on plates should not be bent or otherwise damaged. Replace damaged parts. Install new part if boot retainer is damaged or badly corroded. Remove damaged retainer with a punch or a chisel. Keep spring guide for reuse. Install retainer and bend inner edge to about 45°, locking spring guide in place as shown in figure 18.

Assembly (Fig. 18)

1. Install spring guide, spring, and non-pressure plate on push-rod.

2. Place clamp ring over flange of non-pressure plate and align marks made prior to disassembly.

3. Position diaphragm in pressure plate. Position pressure plate and diaphragm and place brake chamber assembly lightly in a vise. Carefully close vise until clamp ring can be worked over flange of pressure plate. Align marks made prior to disassembly.

4. Use vise-grip pliers or C-clamp on side of lugs on clamp ring. Draw clamp ring together and install one bolt and nut. Remove tool and install the other bolt and nut. Tighten just enough to form an air-tight seal. Remove brake chamber from vise.

5. Ease rubber boot down over push rod and fit large end of boot over edge of boot retainer. Install lock nut and yoke on push rod.

SLACK ADJUSTERS

Slack adjusters function as adjustable levers and provide a quick and easy method for adjusting brakes to compensate for normal lining wear. Positive locking type slack adjusters are used at front and rear brakes. Construction of both front and rear slack adjusters is shown in figure 19. Front and rear slack adjuster installations are shown in figures 20 and 21.

Slack adjuster consists basically of a hardened steel gear, which is splined to the brake camshaft, a brake lever (body), and hardened steel

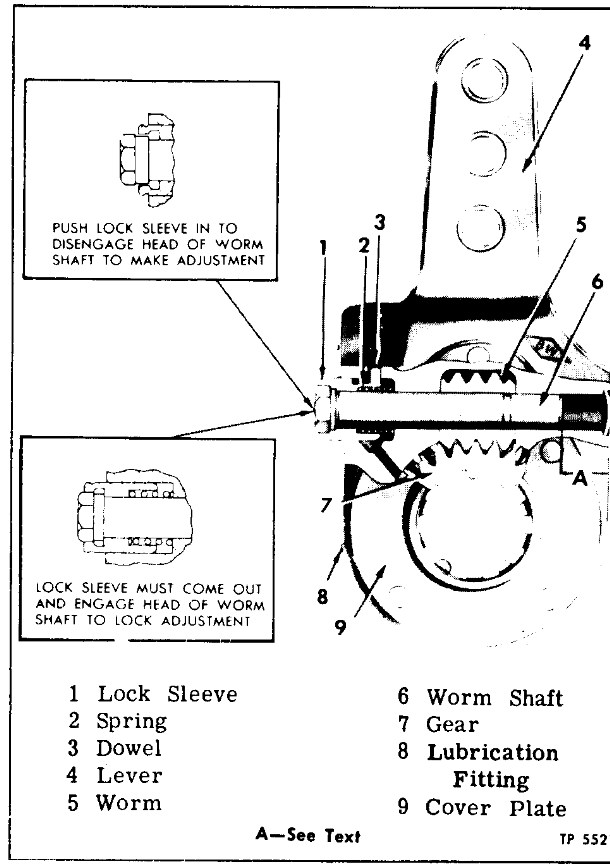


Figure 19—Slack Adjuster (Typical)

worm which is mounted in the lever above the gear, and meshes with teeth in gear. Turning the worm shaft causes rotation of camshaft in relation to brake lever. During brake operation, the entire slack adjuster rotates bodily with the camshaft. As brake chamber push rod reaches its maximum travel due to normal lining wear, turning worm shaft rotates lever back to original setting.

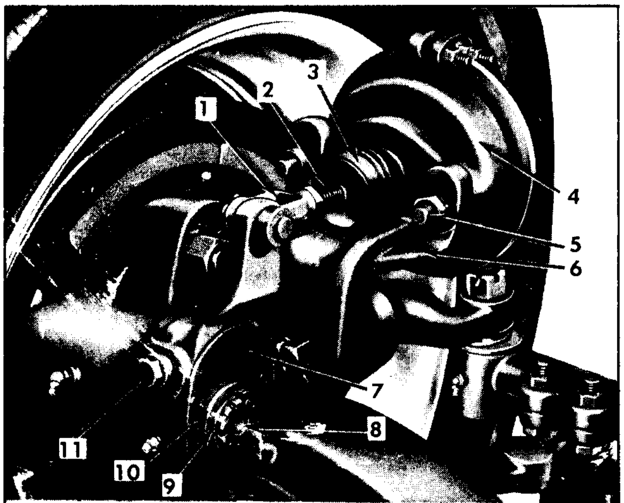
SLACK ADJUSTER SERVICEABILITY TEST

Adjust brakes as previously directed under "Brake Adjustment" in this section; then carefully measure brake chamber push rod travel as brakes are applied. Make several full brake applications and again measure push rod travel. Push rod travel should be the same as it was immediately after adjustment. If push rod travel increases, or if difficulty is experienced in keeping brakes adjusted in service, slack adjuster must be overhauled or replaced.

SLACK ADJUSTER REPLACEMENT

Removal (Fig. 20 or 21)

1. Remove clevis pin attaching slack adjuster to brake chamber push rod.



1 Push Rod Yoke
2 Push Rod
3 Rubber Boot
4 Brake Chamber
5 Brake Chamber Mounting Stud
6 Brake Chamber Bracket
7 Slack Adjuster
8 Camshaft
9 Snap Ring
10 Washer
11 Slack Adjuster Worm Shaft

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Figure 20—Brake Chamber, Bracket, and Slack Adjuster Mounted on Axle (Front)

2. Remove snap ring and washer (front) or bolt and washers (rear) securing slack adjuster on camshaft. Slide slack adjuster off end of shaft.

Installation (Fig. 20 or 21)

1. If a new slack adjuster is being installed, make sure it is the same size and type as the one removed. Slide slack adjuster onto camshaft and attach with bolt and washers(rear) or with snap ring and washer (front).

2. Connect brake chamber push rod to slack adjuster, using clevis pin and new cotter pin.

3. Lubricate slack adjuster as directed in LUBRICATION (SEC. 13) of this manual.

4. Adjust brakes as previously directed under "Brake Adjustments."

SLACK ADJUSTER OVERHAUL

Disassembly (Fig. 19)

1. Remove dirt and grease from outside of unit by washing in suitable cleaning solvent.

2. Cut off riveted ends of rivets attaching cover plates to body. Drive out rivets and remove cover plates.

3. Remove welch plug from end of worm shaft bore. Insert a flat end punch into the worm shaft bore and drive worm shaft out of body and worm.

4. Remove lock sleeve and spring from worm shaft. Remove gear and worm from slack adjuster body. Remove lubrication fitting.

Inspection and Repair

1. Wash parts in cleaning solvent and wipe or blow parts dry.

2. Inspect worm and gear and replace with new parts if chipped or broken teeth are evident.

3. Inspect worm shaft for wear. Make sure corners on hex end are not rounded.

4. Inspect bushing in lever arm. If worn, out-of-round, or otherwise damaged, it must be replaced. To replace bushing, press old bushing out and press new bushing into place. Bushing must be reamed after installation to 0.501"-0.503".

5. Examine lock sleeve for cracks or other damage. Replace if necessary.

6. Examine lever (body) for cracks or distortion. If lever is damaged in any way, a new body and bushing assembly must be used.

Assembly (Fig. 19)

1. Place worm and gear assembly in position in body.

2. Place lock sleeve over worm shaft, with socket-like end of sleeve at hex end of shaft. Place lock spring in recess formed by sleeve and shaft.

3. Enter small end of worm shaft through hole in body and worm. Press worm shaft into worm and body, making sure the groove in lock sleeve is aligned with pin in body. Press shaft in until distance from small end of shaft to edge of body (A, fig. 19) is 9/16". Install welch plug in worm shaft bore.

4. Position cover plates on body and attach with new rivets. Covers must be flat and in good contact with body after riveting.

5. Install lubrication fitting in body. Connect a grease gun to fitting and force grease into slack adjuster until it is completely filled. Refer to LUBRICATION (SEC. 13) of this manual for type of lubricant.

FRONT BRAKE SHOES, LININGS, AND CAMSHAFTS

SHOES AND LININGS

Brakes at each front wheel have two shoes which pivot on anchor pins at one end and are expanded at the other end during brake application by constant lift S-type cams. Brake shoe return springs hold shoe ends firmly against cam. Two-piece block type lining is bolted to each shoe. Holes through lining and upper shoe at cam end are provided to facilitate removing and installing return springs.

Cam end of each shoe is equipped with a roller which acts as contact between shoe and cam. Roller shaft is integral with roller and rides in a groove

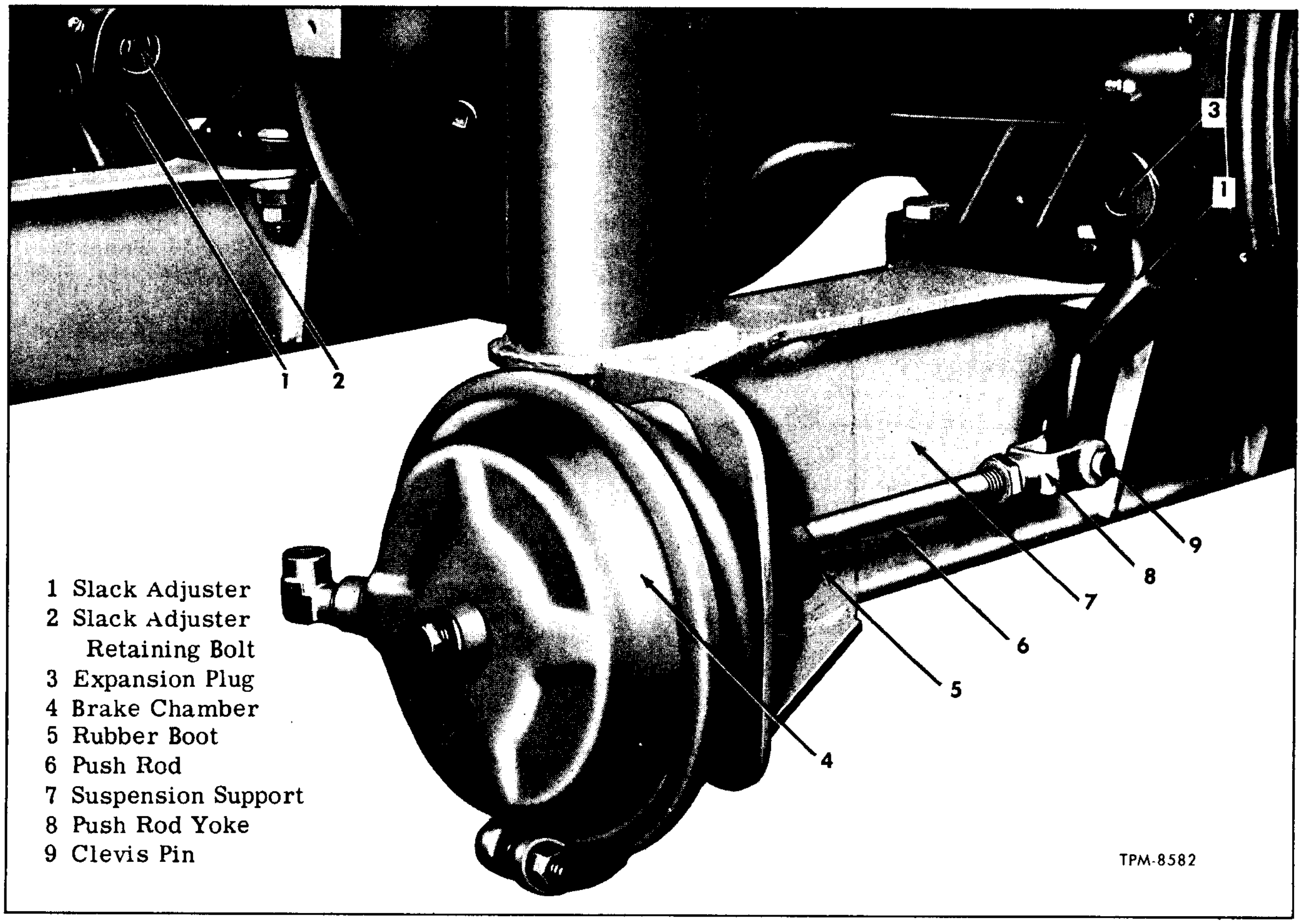


Figure 21—Rear Brake Chamber and Slack Adjuster Mounting

at toe end of shoe web. Shoe return springs hold roller securely between cam and toe of shoe.

CAMSHAFTS

Front brake camshafts are mounted in two bushings in brake spider (fig. 22). Lubrication fitting in spider provides method for lubricating bushings. Lubricant is retained by seals which are pressed into spider.

ANCHOR PINS

Anchor pin end of each shoe fits between brackets at brake spider, and is retained by straight type anchor pin (fig. 23). Both anchor pins are held in place by a lock plate which engages notches in end of each pin and is attached to brake spider by a cap screw. Anchor pin ends of shoes are equipped with replaceable bushings.

FRONT BRAKE SHOE AND CAMSHAFT REMOVAL

1. Jack up front axle and remove wheel and brake drum. Remove hub as directed in "HUBS AND BEARINGS" (SEC. 19) of this manual.

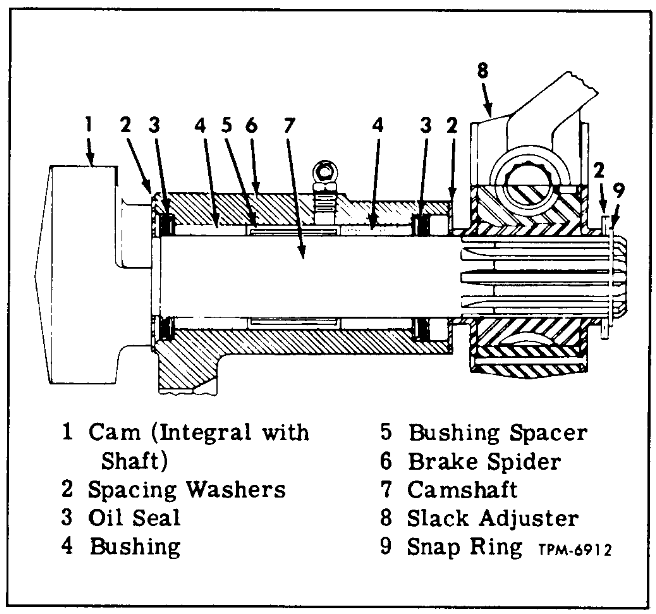


Figure 22—Front Brake Camshaft and Slack Adjuster Mounting

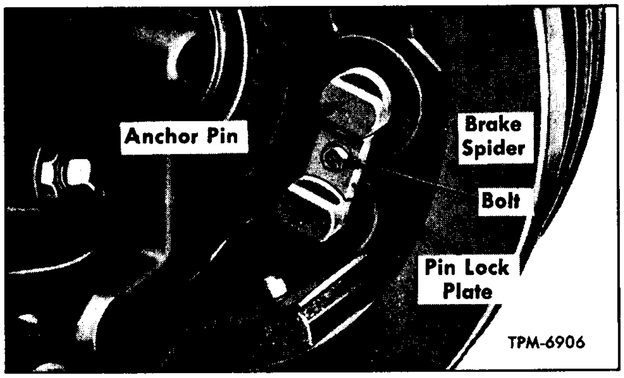


Figure 23—Front Brake Shoe Anchor Pins Installed (Typical)

2. Drive plugs out of lining at cam end of upper shoe, using a punch through holes in shoe. Using a hooked tool through holes in lining and shoe, unhook springs from pin in upper shoe. Remove springs from pin in lower shoe. Tag or mark shoes so they may be reinstalled in their original position.

3. Remove anchor pin lock plate. Drive anchor pins out of brake spider and shoes; then remove brake shoes.

4. To remove camshaft (fig. 22), disconnect brake chamber push rod yoke from slack adjuster. Remove snap ring and washer securing slack adjuster on camshaft and pull slack adjuster off end of shaft. Pull camshaft out of brake spider, stripping spacing washers off shaft as shaft is removed.

INSPECTION

1. Wash all parts except shoe and lining assemblies in cleaning solvent. Check anchor pins and brake shoe bushings for wear in accordance with dimensions listed in "Specifications" at end of this group. Replace with new parts any that are badly worn. If brake shoe bushings are replaced, burnish after installation.

2. Examine camshaft bushings, spacer, and seals. If there is any indication of wear or damage, remove old parts and replace with new. Remove seals; then remove bushings by inserting tool through spider and tapping on inside end of each bushing. When installing new bushings, carefully drive into place with a suitable driver. Install spacer between bushings. New seals should be soaked in oil until soft and pliable before installing. Seals should be installed with tapered edge out to permit installation of camshaft without damage.

3. Check fit of roller hubs in shoes. If excessive looseness is evident, remove rollers and check for wear. Replace worn parts. Lubricate roller hubs before installing.

4. Check tension of brake shoe return springs. Replace if weak or broken.

5. Check thickness of brake lining at center of shoe. If worn down to 5/16" thickness, lining must be replaced. When replacing linings, lining with return spring access holes must be installed at cam end of upper shoe. Linings must be securely bolted to shoes. New lock washers should be used and nuts tightened to 20-25 foot-pounds torque. A 0.006" feeler must not enter between shoe and lining at any point. Drive lining plugs into bolt holes in lining when installation is completed. Make sure roller in shoe is standard size when new linings are installed.

6. Examine camshaft for cracks, distortion, or wear at the bushing surfaces. Replace if worn or damaged.

7. If brake drums have been machined oversize, refer to instructions under "Brake Drums" later in this section.

FRONT CAMSHAFT AND BRAKE SHOE INSTALLATION

1. Work lubricant into camshaft bushings. Refer to LUBRICATION (SEC. 13) for type lubricant.

2. Install large spacing washer on camshaft and insert camshaft through bushings in spider (fig. 22), being careful not to damage oil seals.

3. Install brake shoes at brake spider in same position from which they were removed. Insert anchor pins through brake spider and shoes. Turn anchor pins so notches in inner end face each other. Install anchor pin lock plate and secure with cap screw and lock washer (fig. 23).

4. Hook one end of brake shoe return springs on pin in lower brake shoe. Stretch springs and hook onto pin in upper shoe, using hooked tool through holes in lining and shoe. Drive lining plugs into holes after hooking springs.

5. Place spacing washer and spacer over inner end of camshaft (fig. 22), install slack adjuster on camshaft, and secure with washers and snap ring. Connect brake chamber push rod yoke to slack adjuster, using clevis pin and cotter pin. Back off slack adjuster worm shaft until shoe rollers rest on lowest points on cam.

6. Install hub, drum, and wheel, and adjust bearings, as directed in "HUBS AND BEARINGS" (SEC. 19) of this manual.

7. Adjust brakes as previously directed under "Brake Adjustment" in this section.

8. Lubricate camshaft bearings as directed in LUBRICATION (SEC. 13) of this manual.

REAR BRAKE SHOES, LININGS, AND CAMSHAFTS

SHOES AND LININGS

Brakes at each rear wheel have two shoes which pivot on anchor pins at one end and are expanded at the other end during brake application, by constant lift S-type cams. Brake shoe return springs

hold shoe ends firmly against cam. Two-piece block type lining is bolted to each shoe. Hole through lining and upper shoe at cam end are provided to facilitate removing and installing springs. Cam end of each shoe is equipped with a roller which forms the contact between shoe and cam.

ANCHOR PINS

Heel of each brake shoe is attached to anchor pins which are installed in brake spider as shown in figure 24. Shoes are retained on anchor pins by a strap, two tapered dowels, two lock washers, and two nuts. Spacing washers are used as required to provide proper fit of shoe end between spider and strap.

CAMSHAFTS

Camshafts are mounted in bushings in brake spider. Mounting is similar to front camshaft mounting shown in figure 22. Lubrication fitting in spider lubricates bushings. Lubricant is retained by seals pressed into spider.

REAR BRAKE SHOE REMOVAL

1. Jack up rear axle and remove wheels and brake drum. Remove hub as directed in "HUBS AND BEARINGS" (SEC. 19) of this manual.

2. Drive plugs out of lining at cam end of upper shoes. Using a hooked tool through holes in linings and shoes, unhook springs from pins in upper shoes. Remove springs from pin in lower shoe.

3. Tag or mark brake shoes so that they may be reinstalled in original position.

4. Remove nut and lock washer from each anchor pin; then remove anchor pin strap and spacing washers. Remove brake shoes and anchor pin springs from anchor pins.

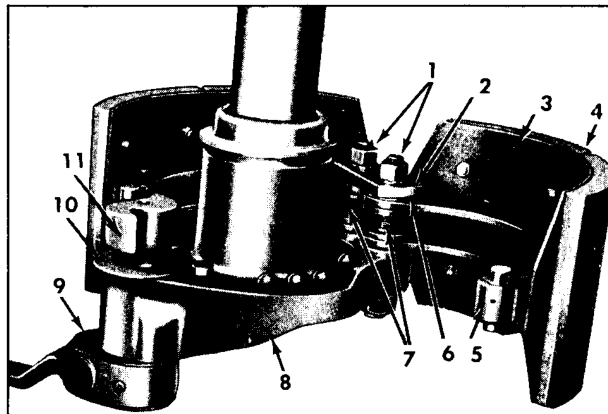
BRAKE SHOE INSPECTION

1. Check anchor pins and brake shoe bushings for wear using "Specifications" at end of this group. Replace badly worn parts with new parts. Burnish brake shoe bushings after installation.

2. Check fit of roller hubs in shoes. Replace worn parts. Lubricate roller hubs before installing roller.

3. Check tension of brake shoe return springs. Replace weak or broken springs.

4. Check thickness of brake lining at center of shoe. If worn down to 5/16" thickness, lining must be replaced. When replacing lining, lining with return spring access holes must be installed at cam end of upper shoes. Linings must be securely bolted to shoes. New lock washers should be used and nuts should be tightened to 20-25 foot-pounds torque. A 0.006" feeler must not enter between lining and shoe at any point. Drive lining plugs into bolt holes in lining when installation is completed. Make sure roller in shoe is standard size when new linings are installed.



1 Anchor Pins	7 Anchor Pin Springs
2 Lock Plate	8 Spider
3 Brake Shoe	9 Slack Adjuster
4 Lining	10 Washer
5 Roller	11 Cam (Integral with Shaft)
6 Washer	

TPM 8664

Figure 24—Rear Brake Anchor Pins Installed

REAR BRAKE SHOE INSTALLATION

1. Apply a thin coat of Lubriplate to anchor pins, roller hubs, and O.D. of shoe return spring coils.

2. Position each brake shoe heel on anchor pins, with anchor pin springs positioned on shoes, as shown in figure 24.

3. Place one spacing washer on outer end of each anchor pin. Thickness of washer should leave 0.030" to 0.060" clearance between shoe web and anchor strap. Install strap, dowels, lock washer, and nuts on anchor pins. Tighten firmly. Make sure shoes do not bind on pins.

4. Hook one end of brake shoe return spring on pin on lower shoe. Position roller in toe of each shoe; then using a hooked tool through hole in lining and shoe, stretch spring and hook on spring pin in upper shoe. Drive lining plug into hole after hooking spring.

5. Back off slack adjuster worm shaft until shoe rollers rest on lowest points on cam. Install hub, brake drum, and wheel as directed in HUBS AND BEARINGS (SEC. 19) of this manual.

6. Adjust brake shoes as previously directed under "Brake Adjustments" in this section.

REAR CAMSHAFT REMOVAL

1. Unhook brake shoes as directed in "Rear Brake Shoe Removal," steps 1 and 2. Swing brake shoes away from cam. Rear camshaft mounting is similar to front mounting shown in figure 22.

2. Disconnect brake chamber push rod yoke

from slack adjuster. Remove bolt, lock washer, and flat washer securing slack adjuster on camshaft.

3. Pull slack adjuster off end of shaft. Pull camshaft out of brake spider, stripping off spacing washers as shaft is removed.

CAMSHAFT INSPECTION

1. Wash parts in cleaning solvent.

2. Examine camshaft for cracks, distortion, or wear at bearing surface. Replace if worn, or damaged.

3. Examine bushings in brake spider. Replace with new bushings if wear or damage is evident. Replace bushings as follows:

a. Remove oil seals; then remove bushings by inserting a flat punch through spider and tapping on inside end of each bushing.

b. Using a suitable driver, carefully drive new bushings into place. Install bushing spacer between bushings. Soak new oil seals in oil for one hour before installing in spider.

REAR CAMSHAFT INSTALLATION

1. Coat bushings in brake spider with lubricant.

2. Place large spacing washer over splined end of camshaft.

3. Insert splined end of shaft through bushings in brake spider.

4. Install spacing washer and slack adjuster on inner end of camshaft. Attach with flat washer, lock washer, and bolt. Connect brake chamber push rod to slack adjuster.

5. Secure brake shoes as directed in "Rear Brake Shoe Installation," steps 4 and 5.

6. Install hubs, brake drums, and wheels as directed in "HUBS, WHEELS, AND TIRES" (SEC. 19) of this manual.

7. Adjust brake shoes as previously directed under "Brake Adjustments." Lubricate spider bushings and slack adjuster as directed in LUBRICATION (SEC. 13) of this manual.

BRAKE DRUMS

When brake drums become scored, they may be refaced by machining or grinding. To compensate for increased inside diameter of refaced drums, 1/16" and 1/8" oversize brake linings are available from the lining manufacturers. When drums are refaced, they should be machined in increments of 1/16-inch and linings oversize the amount machined from the drum installed.

Satisfactory operation with oversize linings will be obtained until the lining becomes worn sufficiently to permit the brake shoe roller to pass the high point on the cam without effectively applying the brakes.

NOTE: To avoid misunderstanding the term "oversize" as applied to linings and drums, the following example applies:

<u>1/8" Oversize Brake Drum</u>

Inside diameter (I.D.) of the brake drum has been increased 1/8"; that is 1/16" of metal has been removed around the circumference of the drum.

<u>1/8" Oversize Lining</u>

Linings are 1/16" thicker than standard, thus the total increased thickness of linings on both shoes compensates for the 1/8" increased diameter of drum.

Brake drums should never be machined to more than 1/8" beyond original diameter.

AIR BRAKE SPECIFICATIONS

	FRONT	REAR
Brake Size	14½" x 5"	14½" x 8"
Brake Drum		
Inside Diameter	14.500"-14.510"	14.500"-14.510"
Width Braking Surface	5"	8"
Maximum Allowable Out of Round	0.010"	0.010"
Brake Lining		
Width	5"	8"
Thickness	¾"	¾"
Piece Per Shoe	2	2
Effective Brake Area	294 sq. in.	470 sq. in.
Brake Shoe Return Spring		
Free Length	8$^{11}/_{16}$"	8½"
Length @ Lbs. Pull	9$^{13}/_{32}$" @ 32-38	9$^{13}/_{32}$" @ 113-137
Camshaft		
Overall Length	9$^{11}/_{32}$"	7$^{35}/_{64}$"
Length of Shaft	7$^{15}/_{16}$"	5$^{31}/_{64}$"
Diameter at Bushings	1.493"-1.495"	1.493"-1.495"
Width of Cam	1.750"	2.340"
Diameter of Cam	3.875"	3.880"
Number of Splines	10	10
Bushing		
Width	1.245"-1.255"	1.245"-1.255"
Outside Diameter	1.876"-1.878"	1.876"-1.878"
Inside Diameter	1.501"-1.503"	1.501"-1.503"
Cam Roller In Shoe		
Width Hub to Hub	1.734"	2.288"-2.298"
Width Contact with Cam	0.790"-0.800"	1.290"-1.300"
Diameter Roller	1.488"-1.492"	1.488"-1.492"
Diameter Hub	0.740"-0.745"	0.740"-0.745"
Anchor Pins		
Outside Diameter	1.2465"-1.2485"	1.2465"-1.2485"
Length	4⅜"	6⅞"
Bushing		
Width	⅝"	⅝"
Outside Diameter	1.503"-1.505"	1.503"-1.505"
Inside Diameter	1.255"-1.257"	1.255"-1.257"
Spring		
Free Length	—	0.88"-0.91"
Compressed Length	—	0.63"-0.66"
Brake Chambers		
Type	24	30
Diameter (Overall)	7¼"	8⅛"
Spring Force at 0 Stroke	30¾ lbs.	39½ lbs.
Spring Force Increase Per Inch of Stroke	8 lbs.	10½ lbs.
Maximum Stroke	2¼"	2½"
Minimum Stroke (with Brake Adjusted)	⅝"-¾"	1⅛"-1¼"
Effective Diaphragm Area	24 sq. in.	30 sq. in.
Push Rod Spring		
Free Length	—	7$^{17}/_{32}$"
Compressed Length	—	1⅛"
Slack Adjusters		
Type	20-2	20-2
Length Between Hole Centers	5¾"	7"
Number of Splines	10	10
Bushing		
Width	0.484"	0.484"
Inside Diameter	0.504"	0.504"
Outside Diameter	0.628"	0.628"
Spring		
Free Length	1$^{9}/_{64}$"	1$^{9}/_{64}$"
Compressed Length	$^{19}/_{64}$"	$^{19}/_{64}$"

(Continued on next page)

AIR BRAKE SPECIFICATIONS (CONT.)

VALVE SPRINGS

Pressure Regulator Valve Spring	
Free Length	$2\frac{13}{64}$"
Compressed Length	$1\frac{9}{16}$"
Relay Valve Spring	
Free Length	$1\frac{11}{32}$"
Compressed Length	$\frac{39}{64}$"
Check Valve Spring	
Free Length	0.750"
Compressed Length	0.441"
Brake Application Valve	
Piston Return Spring	
Free Length	$1\frac{17}{32}$"
Compressed Length	$\frac{1}{2}$"
Valve Spring	
Free Length	$1\frac{21}{32}$"
Compressed Length	$\frac{13}{32}$"
Limiting and Quick Release Valve Spring	
Free Length	$1\frac{5}{64}$"
Compressed Length	$\frac{1}{4}$"
Cut-Off Valve Spring	
Free Length	$1\frac{7}{64}$"
Compressed Length	$\frac{11}{64}$"
Ejector Valve Spring	
Free Length	$1\frac{15}{32}$"
Limiting Valve	
Plunger Return Spring	
Free Length	$\frac{43}{64}$"
Compressed Length	$\frac{11}{64}$"
Valve Spring	
Free Length	$\frac{43}{64}$"
Compressed Length	$\frac{11}{64}$"
Low Pressure Indicator Spring	
Free Length	$1\frac{3}{64}$"
Compressed Length	$\frac{41}{64}$"

Air Compressor and Governor

(BENDIX-WESTINGHOUSE TU-FLO 500)

AIR COMPRESSOR

Air compressor is a two-cylinder single-acting, reciprocating type unit. Compressor is flange mounted to the gear train cover at the rear end of the engine. Compressor is driven directly from the engine camshaft, and lubricated by the engine lubrication system. The cylinder head and cylinder block are cooled by the engine cooling system. Compressor has a rated capacity of 12 cubic-feet per minute based on its piston displacement when running at a speed of 1250 rpm.

COMPRESSOR DRIVE AND LUBRICATION

A hub with internal fiber teeth is keyed to the front end of the compressor crankshaft and secured by a nut and cotter pin (fig. 1). An internal-toothed fiber drive disc is attached to the engine camshaft gear by four cap screws. A drive coupling with external teeth at each end is carried in the internal teeth of the hub and drive disc, transmitting power from drive disc to the air compressor crankshaft hub.

Oil, under pressure from the engine lubrication system, enters drilled crankshaft through crankshaft rear end cover and is forced through the crankshaft and drilled connecting rods (fig. 8), lubricating bearings, piston pins, and pistons. On early models, oil return tube (fig. 1) connects the crankcase bottom cover to openings in the mounting flange and engine gear train cover. Oil drains into the engine gear train cover, and then into the engine crankcase. On late models, oil return is cast integral with compressor crankcase, and the external return tube is not used.

Two vent holes through the crankcase above the crankshaft front bearing permit equalization of the compressor crankcase pressure with the engine crankcase pressure.

COMPRESSOR AIR INTAKE

Air compressor has forced air intake system. Compressor air inlet port is connected by a tube to top side of engine air box. When each compressor piston is on down stroke, air pressure from engine air box opens compressor inlet valve and forces air into cylinder. This tends to supercharge the compressor, since a greater volume of air flows into the compressor cylinders than when the conventional atmospheric air intake system is used. The use of this type of air intake system also eliminates the compressor air cleaner, since the air in the engine air box is cleaned by the engine air cleaners.

COMPRESSOR OPERATION

Air compressor crankshaft turns continuously while engine is running. Actual compression of air is controlled by the compressor governor, however. Acting with compressor unloading mechanism, governor controls compression of air by loading or unloading compressor when pressure in air system reaches the desired high or low point.

OPERATION WITH UNLOADER VALVES CLOSED (COMPRESSING) (Figs. 2 and 3)

During the downstroke, a partial vacuum is created above each piston. Intake air forces open the inlet valve and air fills cylinder.

As piston starts upstroke, the air pressure on

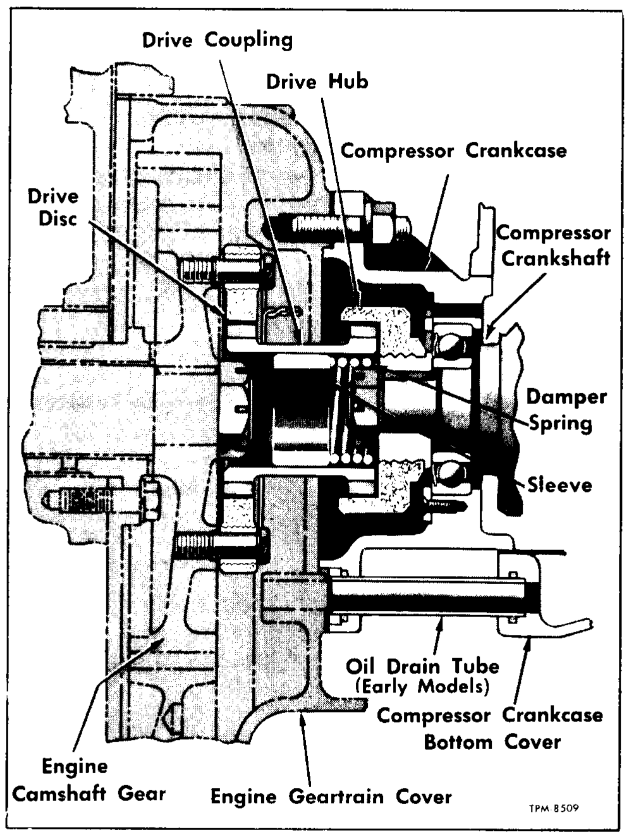


Figure 1—Air Compressor Drive and Oil Return (Typical)

AIR COMPRESSOR AND GOVERNOR

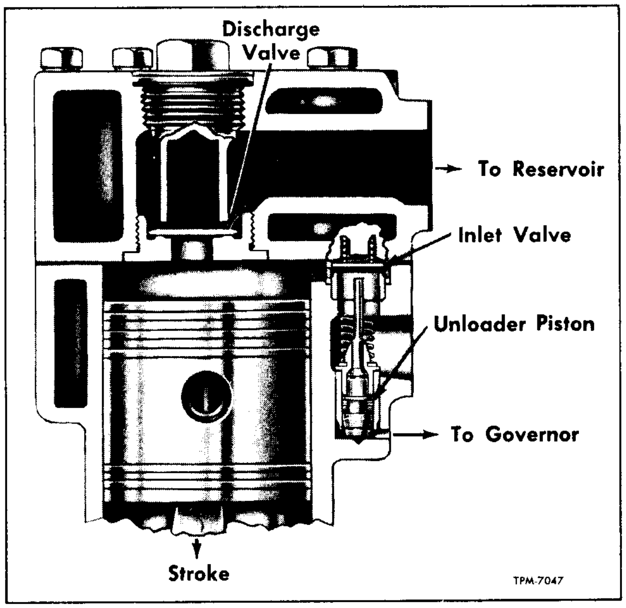


Figure 2—Intake of Air

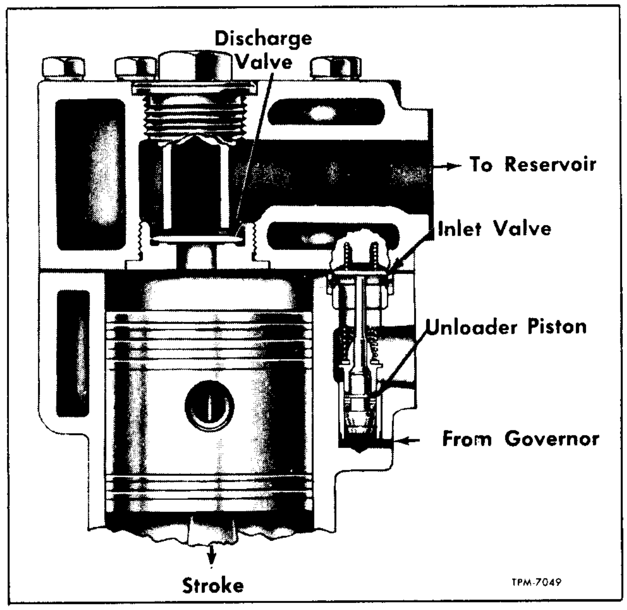


Figure 4—Unloading Compressor

top of inlet valve plus inlet valve return spring force closes the inlet valve. As air above piston is further compressed, pressure lifts discharge valve and compressed air is forced through discharge line into reservoir. At start of downstroke discharge valve returns to seat, blocking return flow of compressed air to cylinder as cycle is repeated.

OPERATION WITH UNLOADER VALVES OPEN (NOT COMPRESSING) (Fig. 4)

When air in system reaches maximum pressure for which governor is set, air passes through governor into unloader cavity below unloader piston cups in compressor cylinder block. Upward movement of unloader pistons caused by air pressure lifts both air inlet valves off inlet valve seats. With both inlet valves unseated, the air intake cavity in the cylinder block forms a passage between the cylinders above the pistons. Upstroke of one piston exhausts air into cylinder of other piston on downstroke, without compression.

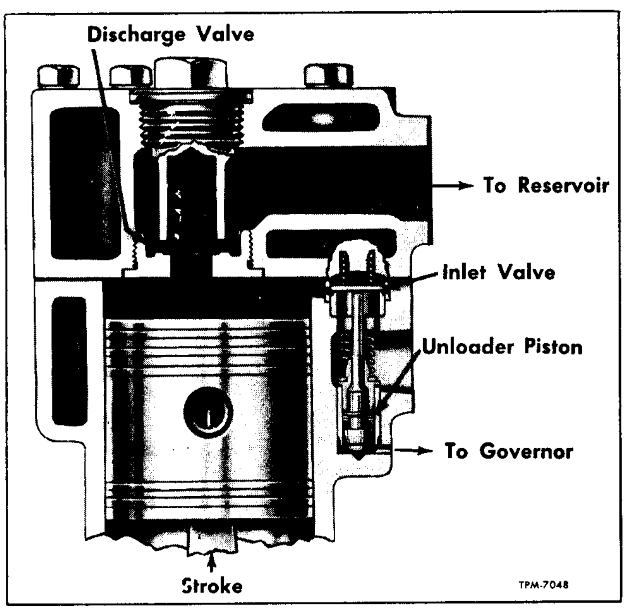


Figure 3—Compression of Air

When pressure in system is reduced to governor cut-in setting, governor releases pressure from beneath unloader pistons. Pressure of unloader spring on spring saddle, acting against reduced governor pressure, forces pistons away from inlet valves. As inlet valve springs in turn overcome reduced plunger pressure, inlet valves reseat and compression is resumed.

COMPRESSOR MAINTENANCE

It is important that inspection and adjustments listed below be made at intervals determined by severity of service.

1. Remove cylinder head and clean carbon away from discharge valves and inlet valves.
2. Check compressor discharge line. Make sure line is not choked with carbon.
3. Check compressor mounting bolts and tighten if necessary.
4. Make sure oil and air lines and connections are tight and free from leaks.
5. When draining engine cooling system to prevent freezing, be sure to remove drain plug from compressor cylinder block.

UNLOADER ASSEMBLY REPLACEMENT

Parts are available in a kit for replacing unloader assembly. Unloader parts (fig. 5) may be changed without removing cylinder head, as follows:

REMOVAL (Fig. 6)

1. Remove air inlet elbow and discard gasket.
2. Insert screwdriver blade under unloader spring and raise spring off unloader spring saddle. Remove spring and spring saddle.
3. Lift each plunger guide and remove guide and plunger. Lift pistons out of bores. If piston is not easily removed, build up air pressure in system until governor cuts out, raising piston. If compressor has been removed from vehicle, use air pressure as shown in figure 6.

INSTALLATION (Fig. 7)

1. Carefully insert each piston, complete with O-ring and back-up ring, in bore.
2. Slide plunger guide down over unloader plunger. Place each guide and plunger in position above unloader piston, then push guide down over top of piston.
3. Install unloader spring and spring saddle. Make sure saddle rests squarely on top of plunger guides, and make sure top of spring engages spring seat in cylinder block.
4. Install new gasket at air inlet and connect air inlet elbow.

COMPRESSOR REPLACEMENT

REMOVAL (Fig. 1)

1. Drain engine cooling system.
2. Disconnect water, air, and oil lines from compressor.

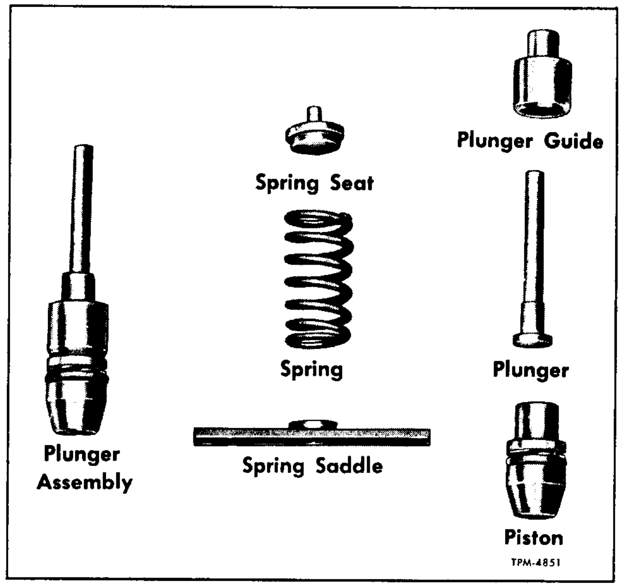


Figure 5—Unloader Assembly Components

3. Remove nuts and lock washers from four studs attaching air compressor to gear train cover. Pull compressor straight back off studs and remove from vehicle.

INSTALLATION (Fig. 1)

1. Clean oil supply line to compressor and if possible, run engine a few seconds to be sure oil supply to compressor is flowing freely.
2. Clean oil passage in compressor crankcase.
3. Lubricate compressor cylinder walls and bearings with lubricating oil before placing compressor in position.
4. Clean or replace any damaged or dirty air lines or water lines which may be corroded before connecting them to the compressor.

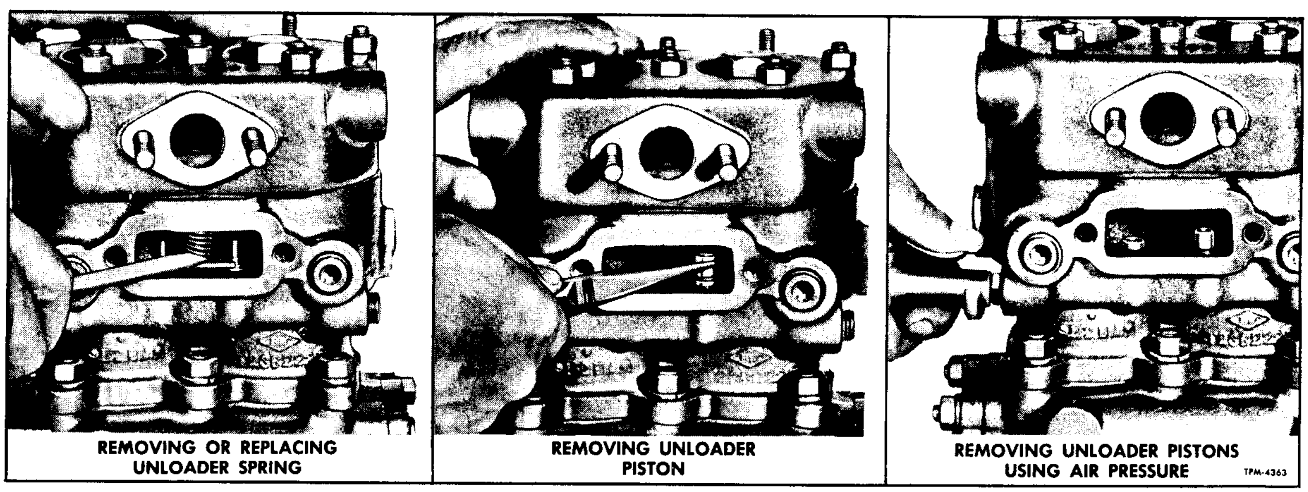


Figure 6—Removing Unloader Components

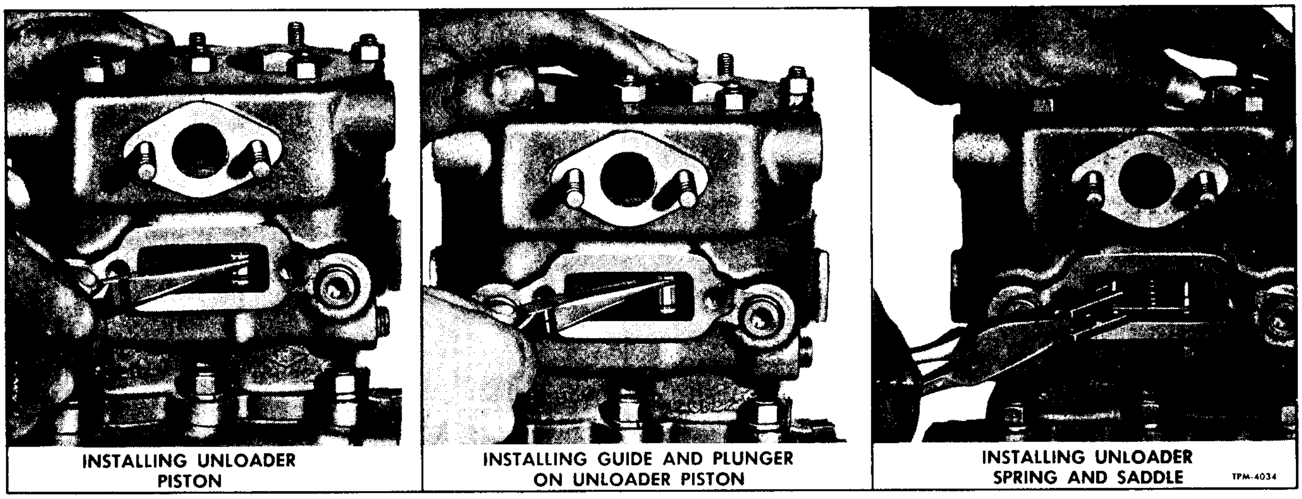


Figure 7—Installing Unloader Components

5. Before installing compressor, examine hub on compressor crankshaft and drive disc on camshaft gear for worn or broken teeth. Check backlash between teeth in hub and teeth on drive coupling, also between teeth in drive disc and teeth on coupling. New limits are 0.000" to 0.001" backlash. If backlash is appreciably greater than this, drive disc or hub (or both) must be replaced.

6. Make sure mating surfaces of air compressor flange and gear train cover are clean. Place new compressor to gear train cover gasket on studs. Make sure gasket around oil return tube (early models) is in place and in good condition.

7. Insert damper spring in drive coupling and place spring end of drive coupling into hub on compressor crankshaft. Place compressor in position on gear train cover, guiding teeth on coupling into mesh with teeth in drive disc. Install nuts and lock washers on studs and tighten firmly.

8. Connect all water, air, and oil lines, making sure connections are tight.

9. Make sure drain plug is installed in compressor cylinder block, then fill cooling system.

COMPRESSOR DISASSEMBLY

The crankcase, crankcase bottom cover, cylinder block, and cylinder head are so designed that method of assembly may be varied to meet different installation requirements. These parts should be marked before disassembling to indicate proper method of assembling.

NOTE: Key numbers in text refer to figure 8.

CYLINDER HEAD REMOVAL AND DISASSEMBLY

1. Remove all cylinder head cap screws, then lift off cylinder head assembly (1). Tap head with soft hammer, if necessary, to break gasket joint.

2. Scrape cylinder head and block, if necessary, to remove any part of gasket (2) sticking to gasket surface.

3. Remove discharge valve cap nuts (36) and lift out discharge valve springs (35) and discharge valves (34). Remove discharge valve seats (33). Remove inlet valve springs (37) and inlet valves (32) from top of cylinder block.

PISTON AND CONNECTING ROD REMOVAL AND DISASSEMBLY

1. Remove screws and lock washers attaching crankcase bottom cover (13) to crankcase, and remove cover and gasket (11). Remove oil drain tube (16) (when used).

2. Before removing, mark each piston. Marks will be used to reassemble parts in original position. Connecting rods and caps have center punch marks showing proper position of cap on rod.

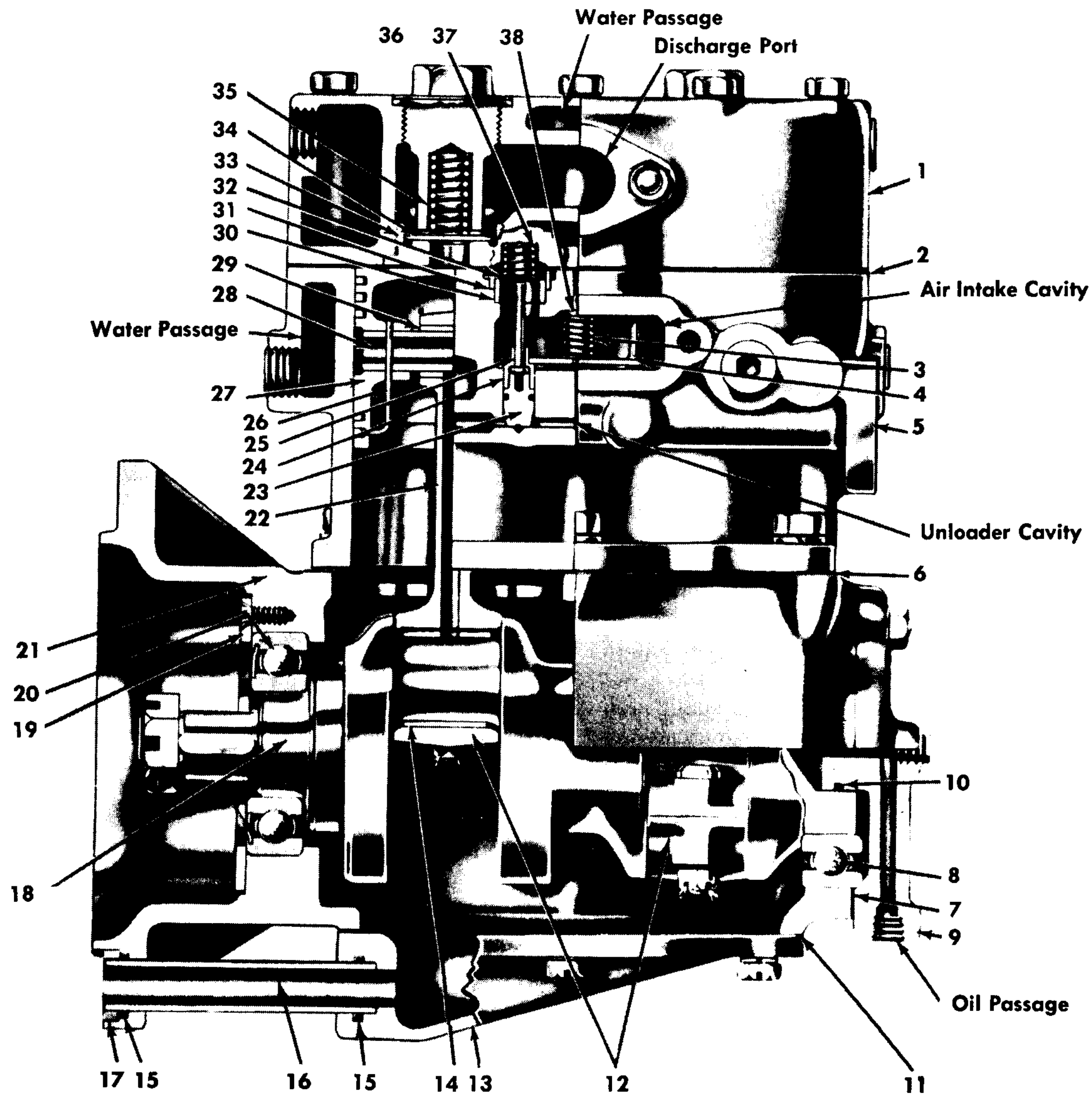
3. Remove cotter pins and nuts from connecting rod bolts. Remove connecting rod bearing caps (12) and bearing inserts (14). Do not remove bolts from rods. Push pistons with connecting rods attached out top of cylinder block. Replace caps on rods with inserts in place to prevent damage to bearing inserts.

4. Remove piston rings from pistons. If connecting rods are to be removed from pistons, remove piston pin lock wires (26), then press piston pins (28) out of pistons and connecting rods.

CRANKSHAFT REMOVAL

1. Remove cotter pin and nut from front end of crankshaft and pull drive hub off shaft. Remove drive hub key from keyway in shaft.

2. Remove cap screws attaching rear end cover (9) to crankcase and remove cover and gasket (7). Remove oil seal ring (10) from boss on cover.



1 Cylinder Head	14 Connecting Rod Bearing Insert	26 Piston Pin Lock Wire
2 Cylinder Head Gasket	*15 Oil Drain Tube Seal	27 Piston
3 Unloader Spring	*16 Oil Drain Tube	28 Piston Pin
4 Unloader Spring Saddle	*17 Oil Drain Tube Gasket	29 Connecting Rod Bushing
5 Cylinder Block	18 Crankshaft	30 Inlet Valve Seat
6 Cylinder Block Gasket	19 Crankshaft Front Bearing Retainer	31 Inlet Valve Guide
7 End Cover Gasket		32 Inlet Valve
8 Crankshaft Rear Bearing	20 Crankshaft Front Bearing	33 Discharge Valve Seat
9 Crankcase Rear End Cover	21 Crankcase	34 Discharge Valve
10 Cover Oil Seal Ring	22 Connecting Rod	35 Discharge Valve Spring
11 Crankcase Bottom Cover Gasket	23 Unloader Piston	36 Discharge Valve Cap Nut
12 Connecting Rod Bearing Cap	24 Unloader Plunger Guide	37 Inlet Valve Spring
13 Crankcase Bottom Cover	25 Unloader Plunger	38 Unloader Spring Seat

* On late models, oil return is cast integral with compressor crankcase, eliminating items 15, 16, and 17.

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Figure 8—Air Compressor Assembly (Early Model Shown)

3. Remove three screws attaching crankshaft front bearing retainer (19) to crankcase and remove retainer.

4. Place crankcase on arbor press bed, front (drive) end up, and place blocks under crankcase so pressure will not be placed on rear end cover studs. Pressing on threaded end of crankshaft, press crankshaft and rear bearing out of crankcase.

5. Using a suitable puller, pull rear bearing (8) off crankshaft. Using a bearing driver from inside of crankcase, drive front bearing (20) out of crankcase.

CYLINDER BLOCK REMOVAL AND DISASSEMBLY

1. Remove screws and lock washers securing air compressor governor to cylinder block, then remove governor and governor gasket.

2. Remove cap screws securing cylinder block (5) to crankcase (21), then remove cylinder block and cylinder block gasket (6).

3. Remove unloader spring (3) and unloader spring saddle (4).

4. Remove unloader plungers (25), plunger guides (24), and unloader pistons (23). Remove inlet valve guides (31). NOTE: It may be necessary to use air pressure (with caution) at the governor port of the cylinder block to remove the unloader pistons, after removing the unloader plunger and associated parts.

CLEANING AND INSPECTION OF COMPRESSOR PARTS

CLEANING

1. General. Thoroughly wash all parts in a suitable cleaning fluid to remove all traces of dirt, oil, or grease.

Figure 9—Measuring Cylinder Bore Diameter

2. Cylinder Head. Soak cylinder head in cleaning fluid to loosen carbon from discharge valve cavities and unloading cavity, and to loosen rust and scale. Blow dirt out of all cavities with compressed air. Scrape carbon and dirt from all surfaces. Scrape gasket particles from gasket surfaces.

3. Discharge Valves. Clean discharge valves, if not worn excessively or damaged, by lapping with crocus cloth held on a flat surface.

4. Oil Passages. Thoroughly clean oil passages through crankshaft, connecting rods, and crankcase rear end cover. If necessary, prod oil passages with a piece of wire; then flush passages with cleaning fluid and blow out with compressed air.

5. Cylinder Block. Soak cylinder block in cleaning fluid to loosen carbon and dirt from air intake cavity. Clean rust and scale from water passages. Blow out all passages with compressed air.

6. Pistons. Scrape all carbon and dirt out of ring grooves in pistons. Clean drain holes in oil ring grooves.

7. Ball Bearings. Immerse bearings in cleaning fluid, then brush off old lubricant. Blow bearings dry with compressed air, and wrap in clean cloth. Avoid spinning bearings with air blast, as spinning might damage bearings.

8. Crankcase Bottom Cover. Wash crankcase bottom cover in cleaning fluid. Remove all sediment from sump in bottom of cover.

INSPECTION

1. Cylinder Head. Inspect cylinder head for cracks or breaks. Replace with new head if cracked or damaged.

2. Inlet and Discharge Valve Springs. Discard used inlet and discharge valve springs and replace with new springs.

3. Inlet and Discharge Valves and Seats. Inspect inlet and discharge valves and seats for signs of excessive wear. Replace valves if grooved deeper than 0.003" at point of seat contact. Replace valve seats if condition is such that seats can no longer be refaced.

4. Unloading Pistons and Plungers. Inspect pistons, plungers, and plunger guides for signs of damage or excessive wear. New unloading pistons should slide easily in bores. Check bores for scratches or damage that might increase O-ring wear. Check unloading piston return spring dimension and compare with "Specifications" listed at end of this section. Replace spring if necessary.

5. Crankcase and End Cover. Check crankcase and end cover for cracks or other damage. Replace with new parts if damaged. Check fit of oil seal ring in groove of rear end cover. Ring must be snug fit in groove, and must have 0.008" to

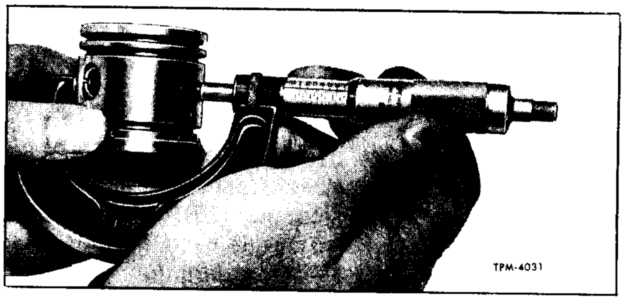


Figure 10—Measuring Piston Diameter

0.015" clearance at gap when placed in end of crankshaft.

6. Crankcase Bearing Bores. Check fit of ball bearings in crankcase bearing bores. Bearings should require a finger press fit. Replace crankcase if bores are worn or damaged.

7. Cylinder Block (Fig. 9). Use telescoping gauge to check bores for out-of-round and taper. Bores which are scored or out-of-round more than 0.002" or tapered more than 0.003" must be rebored, honed, or ground oversize. Pistons and rings 0.010", 0.020", and 0.030" oversize are available. Cylinder bores must be smooth, straight, and round and must be finished with a 500 (or finer) grit hone. The clearance between piston and cylinder wall must not be less than 0.002"or more than 0.004". Replace cylinder block if cracked or damaged.

8. Pistons (Fig. 10). Examine pistons for scoring, cracks, or damage of any kind. Measure outside diameter of piston with a micrometer and compare this measurement with the inside diameter of cylinder bore. Clearance should not be less than 0.002" or more than 0.004". Piston over 0.004" smaller than cylinder bore must be replaced with an oversize piston.

9. Piston Pins and Bushings. Check fit of piston pins in pistons and connecting rods. Pins must be light press fit in pistons. If piston pin is loose in piston, the pin, piston, or both must be replaced. Check fit of piston pins in connecting rod bushings by rocking pins in bushings. If looseness is evident, replace connecting rod bushings as directed under "Compressor Repair." Discard all piston pin lock wires.

10. Piston Rings (Fig. 11). Check fit of piston rings in ring grooves, and check ring gap with ring in cylinder bore. Clearance between rings and sides of ring grooves should be from 0.0035" to 0.0055" for two wide rings and from 0.002" to 0.004" for three narrow rings as shown in figure 12. Ring gap should be from 0.005" to 0.015".

11. Connecting Rods and Bearings. Check fit of connecting rod bearing inserts on crankshaft journals. Clearance between bearings and crankshaft journals must not be less than 0.002" or more than 0.004". Replace bearing inserts if clearance is excessive or if bearings are cracked or flaked. Connecting rod caps are not interchangeable. Position caps so that locking slots are both located adjacent to same cap screw.

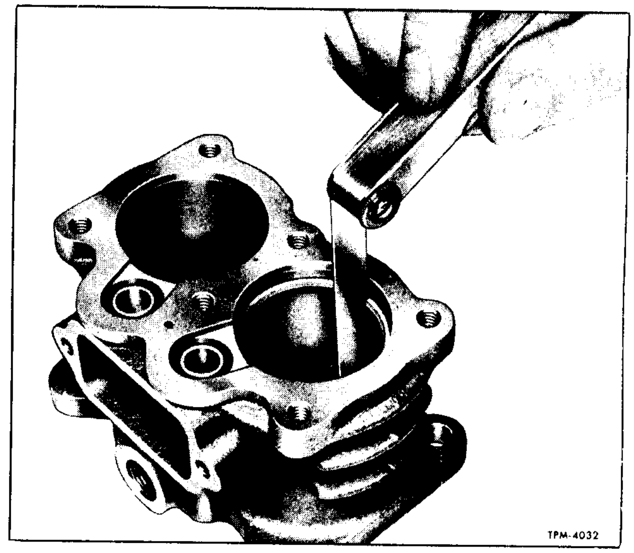


Figure 11—Measuring Piston Ring Gap

12. Crankshaft. Crankshaft journals should not be out-of-round more than 0.001", ridged, or scored. If grinding is necessary, do not grind fillets at ends of journals. Connecting rod bearing inserts are available in 0.010", 0.020", and 0.030" undersize for reground crankshafts. Check main bearing journals for excessive wear. Dimensions should be such that ball bearings are a press fit on journals.

13. Crankshaft Bearings. Examine bearings for wear or flat spots. Replace, if necessary, with new bearings.

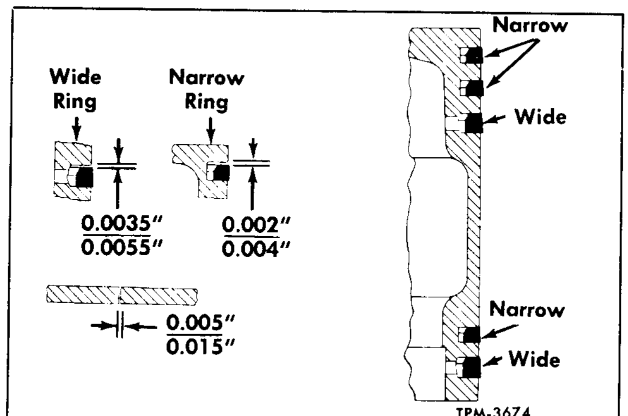


Figure 12—Piston Ring Arrangement and Clearances

COMPRESSOR REPAIR

DISCHARGE VALVE AND SEATS

1. Remove slight scratches and pits from discharge valve seats. Use lapping stone, grinding compound, lapping disc, and valve grinding tool.

2. Place discharge valve on valve seats, install discharge valve springs in cap nuts, and thread cap nuts firmly into cylinder head. To test discharge valves for leakage, connect air line to discharge port in cylinder head. Apply 100 pounds air pressure to valves and apply soap suds to discharge valve openings in bottom of cylinder head. Leakage in excess of a one-inch bubble in one second is not permissible. If leakage is excessive, leave air pressure applied. Using a fiber or a hardwood dowel and a light hammer, tap valves off seats several times. This should improve fit of valve on seat. Check leakage around top of discharge valve cap nuts by applying soap suds to this area. Leakage must not exceed a one-inch bubble in five seconds. Shut off air pressure and disconnect line from cylinder head.

3. Remove discharge valve seats too badly worn for refacing. Thread new seats into head and tighten firmly. With new valves, discharge valve travel should be from 0.056" to 0.070".

INLET VALVES AND SEATS

1. Remove slight scratches or pits from inlet valve seats. Use lapping stone, grinding compound, lapping disc, and valve grinding tool. Replace seats that cannot be repaired. Dimension from the top of cylinder block to the inlet valve seat should not exceed 0.145". After installing new seats, the dimension should be 0.101" to 0.113".

2. Inlet valves not badly worn or damaged can be repaired by lapping valves on a piece of crocus cloth held on a flat surface.

CONNECTING ROD BUSHINGS

If piston pin bushings in connecting rods require replacement as previously indicated in step 9 under "Inspection," press old bushings out of connecting rods. Press new bushings in, making sure the oil holes in the bushings line up with the oil passages in the connecting rods. Bushings must then be reamed, honed, or bored to provide 0.0003" -0.0015" clearance on piston pin.

COMPRESSOR ASSEMBLY

(Key Numbers in Text Refer to Figure 8)

CRANKSHAFT INSTALLATION

1. Press crankshaft rear bearing (8) onto rear end of crankshaft (18), using a bearing driver to exert force on bearing inner race.

2. Insert forward end of crankshaft through bearing bore in rear end of crankcase and press bearing and crankshaft into crankcase (21), using arbor press and bearing driver. Driver must be large enough to exert force on bearing outer race. Press in until the inner edge of the bearing is flush with the inner edge of bearing bore.

3. Turn crankcase over and place a support under rear end of crankshaft and rear bearing. Place crankshaft front bearing (20) over end of crankshaft. (If shielded bearing is used, the shielded side must be up.) Using a suitable bearing driver over end of crankshaft, press bearing on crankshaft and into crankcase until bearing bottoms against shoulder in crankcase. Bearing driver must be of a size to exert force on both the inner and the outer bearing races. Install crankshaft front bearing retainer (19) and attach with three screws. Tighten screws firmly, then stake in place.

4. Install cover oil seal ring (10) in seal ring groove in boss on forward side of crankcase rear end cover (9). Position new end cover gasket (7) over rear end cover studs. Install rear end cover over studs, and make sure that seal ring enters the bore in rear end of crankshaft. Install nuts or studs and tighten.

5. Install key in keyway in front end of crankshaft, install drive hub on shaft, and secure with nut and cotter pin.

CYLINDER BLOCK INSTALLATION (Fig. 13)

Place new cylinder block gasket on crankcase. Position cylinder blocks on crankcase, aligning marks made before disassembly. Install cap screws and lock washers. Tighten firmly.

PISTON AND CONNECTING ROD ASSEMBLY AND INSTALLATION (Fig. 13)

1. Position connecting rod in piston and press piston pin into piston with lock wire holes in pin aligned with lock wire holes in piston.

2. Install new piston pin lock wires in piston pin so that long end extends through piston and pin. Snap short end into lock wire hole at bottom of piston skirt.

3. Install piston rings in grooves of pistons. Rings must be installed in proper location and with pip marks upward. Refer to figure 12 for proper clearance dimensions and location of rings. Stagger position of ring gaps outside of inlet throat area.

4. Press bearing inserts into rod and cap by hand, with locking slots in proper alignment (all slots on side of same cap bolt).

5. Lubricate pistons, rings, piston pin bushings, and bearing inserts with clean engine oil.

6. Turn crankshaft to position bearing journal nearest pulley end of crankshaft (No. 1) downward. Remove bearing cap from No. 1 connecting rod leaving connecting rod bolts in rod.

7. Insert No. 1 connecting rod and piston through top of No. 1 cylinder, as previously mark-

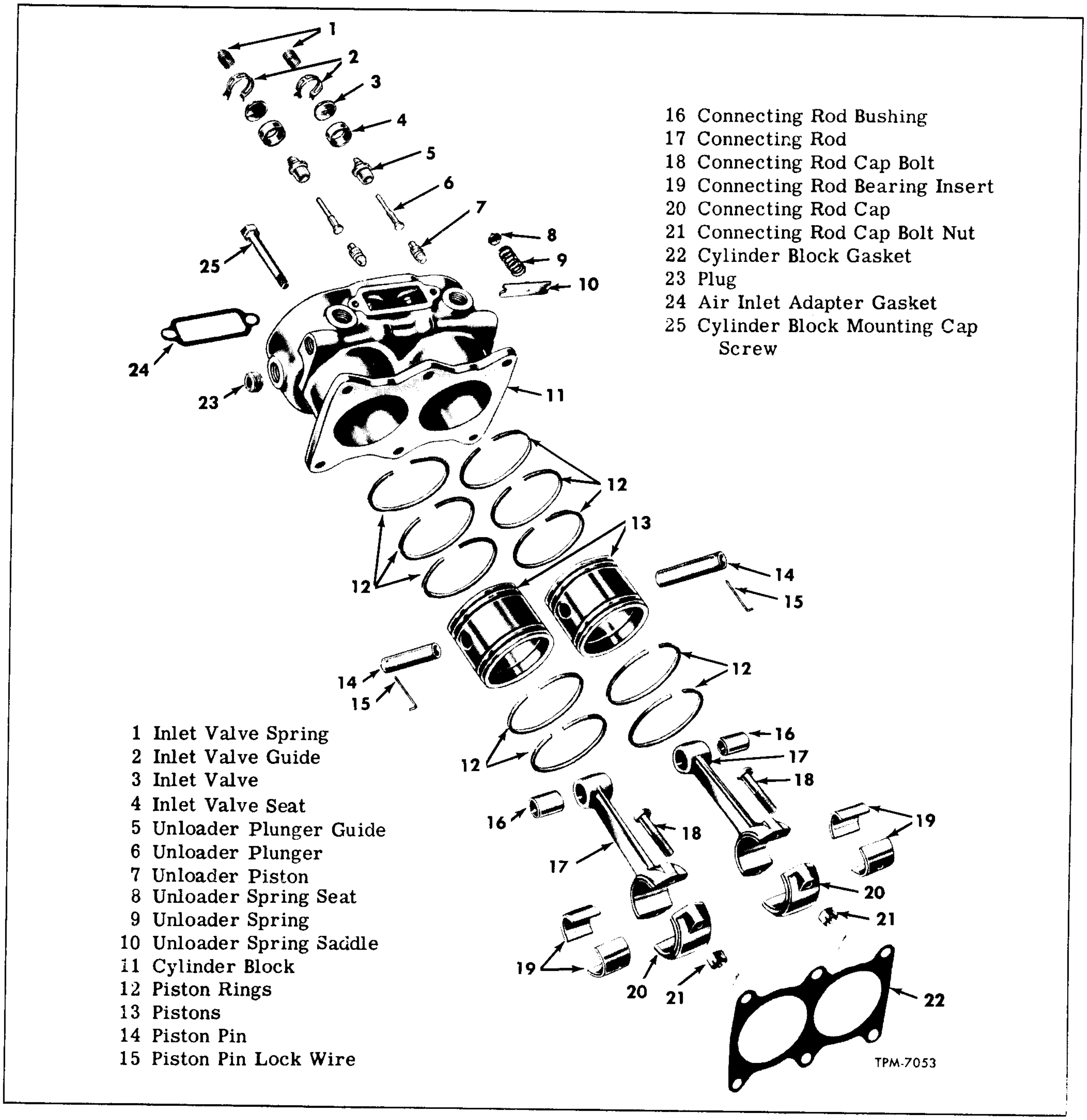


Figure 13—Cylinder Block Components

ed, and seat squarely on connecting rod bearing journal. Install bearing cap. For proper assembly, two slots in bearing inserts and in rod and cap should be on side of same cap bolt. Install nuts and tighten firmly, then install two new cotter pins.

8. Install No. 2 piston and connecting rod in same manner as described above.

9. Install crankcase bottom cover, using a new gasket, with marks made prior to disassembly aligned. Attach cover to crankcase with screws and lock washers.

10. On early models, make sure oil return tube seals are in place in openings in bottom cover and in mounting flange. Insert oil return tube through hole in mounting flange, and press tube through flange and into bottom cover until it is seated in cover. Make sure seals are not dislodged while pressing tube into place.

AIR COMPRESSOR AND GOVERNOR

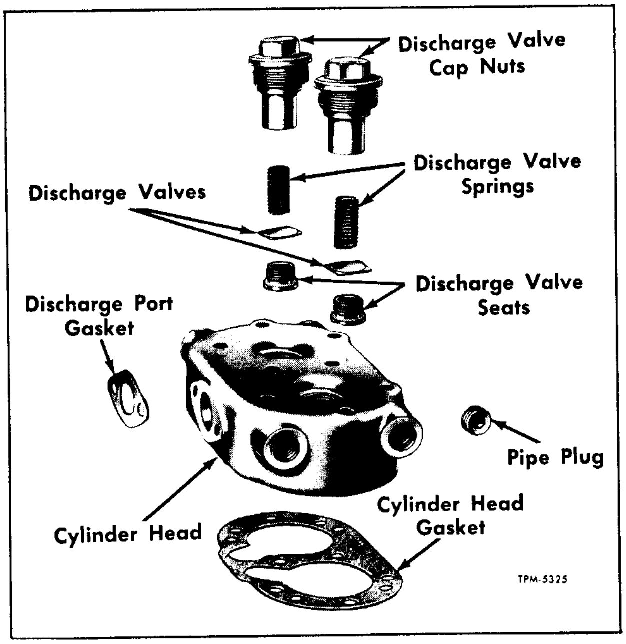


Figure 14—Cylinder Head Components

UNLOADER PISTON AND PLUNGER ASSEMBLY AND INSTALLATION (Figs. 5 and 7)

1. Coat each unloader piston, O-ring, and piston bore with a silicone type lubricant. Insert piston in bore.
2. Insert plunger in plunger guide. Hold guide and plunger with large-nose pliers and install over unloader piston.
3. Install unloader spring saddle and unloader spring. Make certain that saddle rests squarely on top of plunger guides and make sure top of spring engages spring seat pressed into block.

CYLINDER HEAD ASSEMBLY AND INSTALLATION (Fig. 14)

1. Install discharge valve seats (33). Place discharge valve (34) on seat through opening in top of cylinder head. Place discharge valve spring (35) in discharge valve cap nut (36). Thread cap nut into cylinder head. Tighten nuts firmly.
2. Place inlet valves (32), inlet valve guides (31), and inlet valve springs (37) in top of cylinder block.
3. Install new cylinder head gasket (2) on cyl-

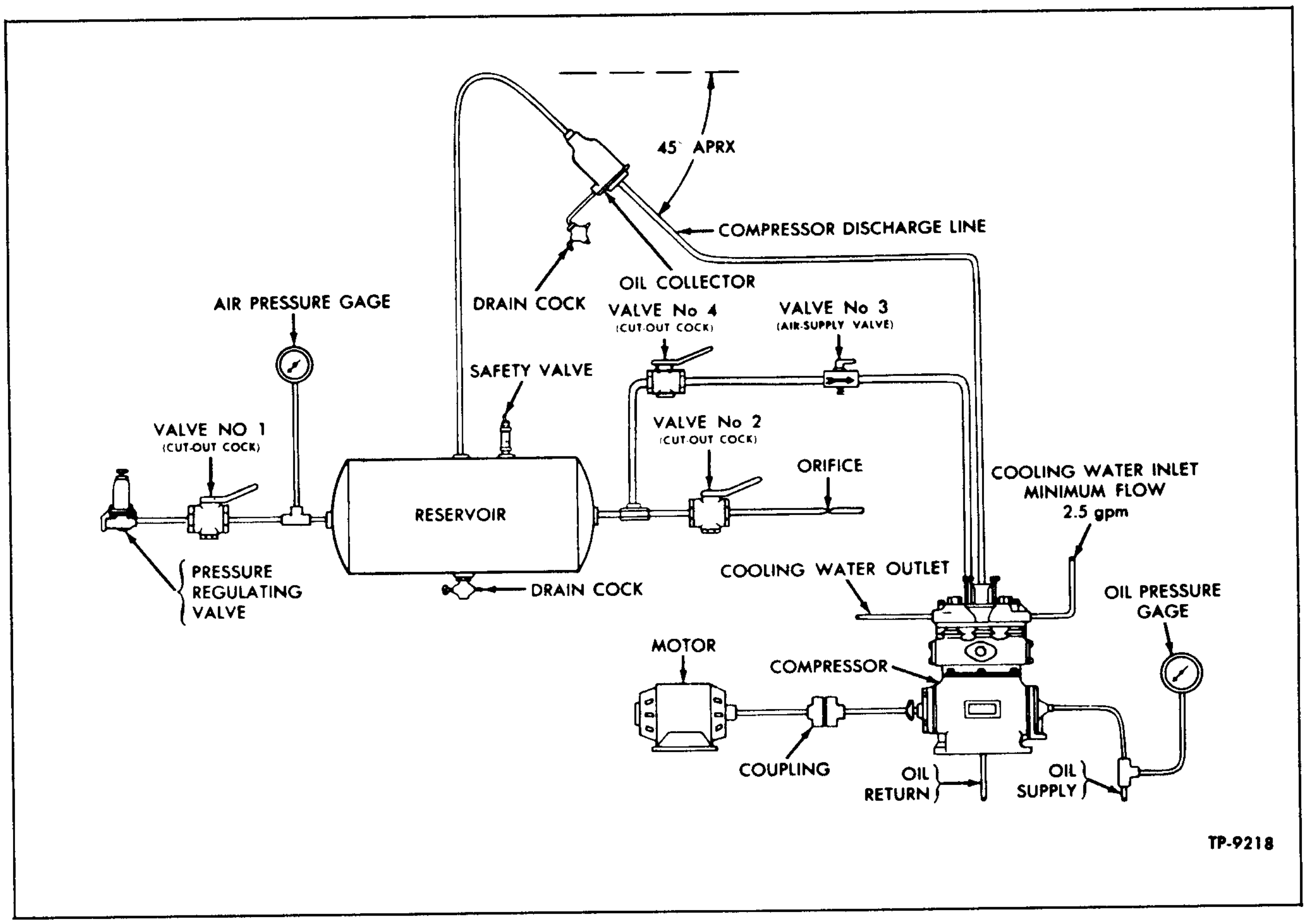


Figure 15—Typical Air Compressor Test Hook-Up

inder block. Carefully align inlet valve springs with inlet valve guides in cylinder head. Align marks made before disassembly and install cylinder head on cylinder block. Install cylinder head cap screws and tighten evenly and firmly. Replace all pipe plugs.

4. Install new gasket and replace air inlet elbow.

COMPRESSOR TESTS AFTER OVERHAUL

After overhauling air compressor, the following tests are recommended to determine if compressor is operating properly. Connect an oil supply line, having at least 15 pounds pressure, to compressor rear end cover opening. Plug other opening in end cover and in crankcase. Provisions must be made for drainage of oil from crankcase during test. Water must be circulated through compressor water passages while compressor is operating. Figure 15 shows a typical test hook-up which can be used to make the following tests.

RUN-IN TEST

Run compressor for one-half hour at 1750 rpm with compressor discharge port open to atmosphere. Check for oil leaks, overheated bearings, and excess noise.

OIL PASSING TEST

Run compressor for one-half hour at 1750 rpm, pumping against 50 psi air pressure with an oil trap connected in the discharge line (fig. 15). Close valves 2 and 4, open valve 1, and adjust pressure regulating valve to maintain 50 psi air pressure in the reservoir. Cover air inlet opening in compressor intake cavity with a plate drilled at center to a 3/8" orifice. Drain the oil collector completely before starting test. At end of half hour test, stop motor and open reservoir drain cock to drain air pressure completely. Open oil collector drain cock to collect and measure oil passed. The oil passed during this test must not exceed 2 cubic centimeters.

EFFICIENCY TEST

This test is made by running compressor one-half hour at 1750 rpm connected to a reservoir fitted with an orifice type exhaust fitting. Close valves 1 and 4 (fig. 15), open valve 2, and mount orifice in line beyond valve 2. Orifice should be 0.089". With air exhausting continuously through orifice, compressor should maintain 75 psi pressure in reservoir.

This test can also be used on a compressor before it is overhauled to determine the necessity of an overhaul. A compressor which does not maintain 60 pounds pressure in reservoir at 1750 rpm should be overhauled.

COMPRESSOR UNLOADER MECHANISM TEST

The compressor unloader can be tested by closing valves 1 and 2 and opening valves 3 and 4 (fig. 15). Run compressor until unloader operates. Watch air pressure. Unloader should operate at 115 to 120 psi, stopping further compression.

UNLOADER PISTON TEST

Unloader piston should be tested by application of 115 psi air pressure through governor line port. When coating unloader pistons with soap suds, leakage should not exceed a 1/2" soap bubble in less than five seconds.

AIR COMPRESSOR GOVERNOR

Air compressor governor, acting in conjunction with the compressor unloading mechanism, automatically limits tank pressure to a preset range. Unloading valves open to stop compression when air pressure is built up to high limit (115-120 psi). Unloading valves close to start compression when air pressure drops to low limit (100-105 psi).

Governor consists essentially of a diaphragm upon which air pressure acts, a spring to control the movement of the diaphragm assembly, and a valve mechanism controlled by the position of the diaphragm assembly, which admits air to, or exhausts air from the unloading mechanism in the compressor cylinder head.

GOVERNOR OPERATION (Fig. 16)

Compressed air from air tank enters the governor at port marked "RES" and passes through strainer. This air pressure is always present above the inlet valve and on one side of the diaphragm.

Cutting Out. As pressure increases, diaphragm and stem assembly moves up against resistance of the pressure setting spring. By the time the tank pressure reaches the cut-out point (115-120 psi), the diaphragm has moved far enough to seat exhaust valve and to open inlet valve. When inlet valve opens, tank air flows past inlet valve and out port marked "UNL" to compressor unloading mechanism. Air pressure opens the unloading valves and stops compression. With inlet valve open, air also flows through the passages in the body to the cavity containing the pressure setting spring. Acting on the area of the stem, the pressure increases effective force on the diaphragm. This further

AIR COMPRESSOR AND GOVERNOR

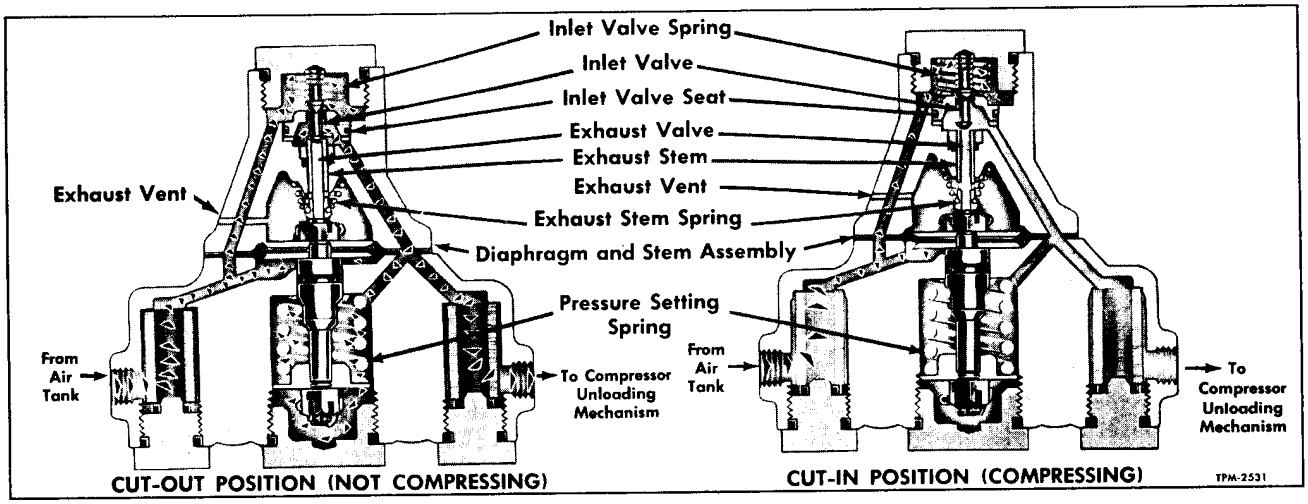


Figure 16—Air Compressor Governor Operation

compresses pressure setting spring and fully opens the inlet valve.

Cutting In. As tank pressure drops to the governor cut-in point (100-105 psi), the pressure acting on diaphragm is reduced. Pressure setting spring expands, moving the diaphragm and stem assembly downward. The inlet valve closes as exhaust valve opens. Unloader air escapes past open exhaust valve, on through hollow exhaust stem, and out exhaust vent in valve body. As air escapes, inlet valves in compressor cylinder block close. Air also escapes from pressure setting spring cavity. This further reduces pressure behind diaphragm and stem assembly. Exhaust valve opens rapidly and completely. Compressor resumes air tank pressure buildup.

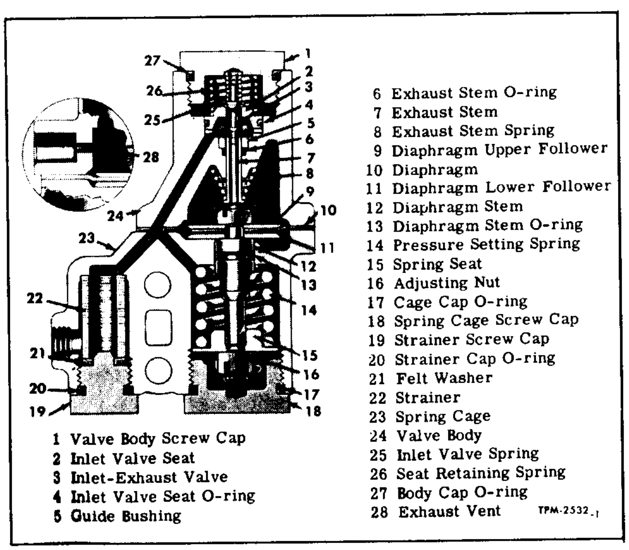


Figure 17—Air Compressor Governor

GOVERNOR TESTS (Fig. 17)

Operating Test

With engine running, build up air pressure in system. Observe reading on air pressure gauge in gauge panel when governor cuts out, stopping further compression. Gauge reading when governor cuts out should be between 115 and 120 psi.

With engine still running, slowly reduce air pressure in system by applying and releasing brakes. Observe pressure registered by gauge when governor cuts in and compression is resumed. Gauge reading when governor cuts in should be between 100 and 105 psi.

Before condemning or adjusting the governor, be sure the dash gauge is registering accurately. Use an accurate test gauge to check the pressure registered by the dash gauge.

Leakage Test

With governor in "cut-out" position, test for leakage at exhaust valve by applying soap suds to exhaust vent in valve body.

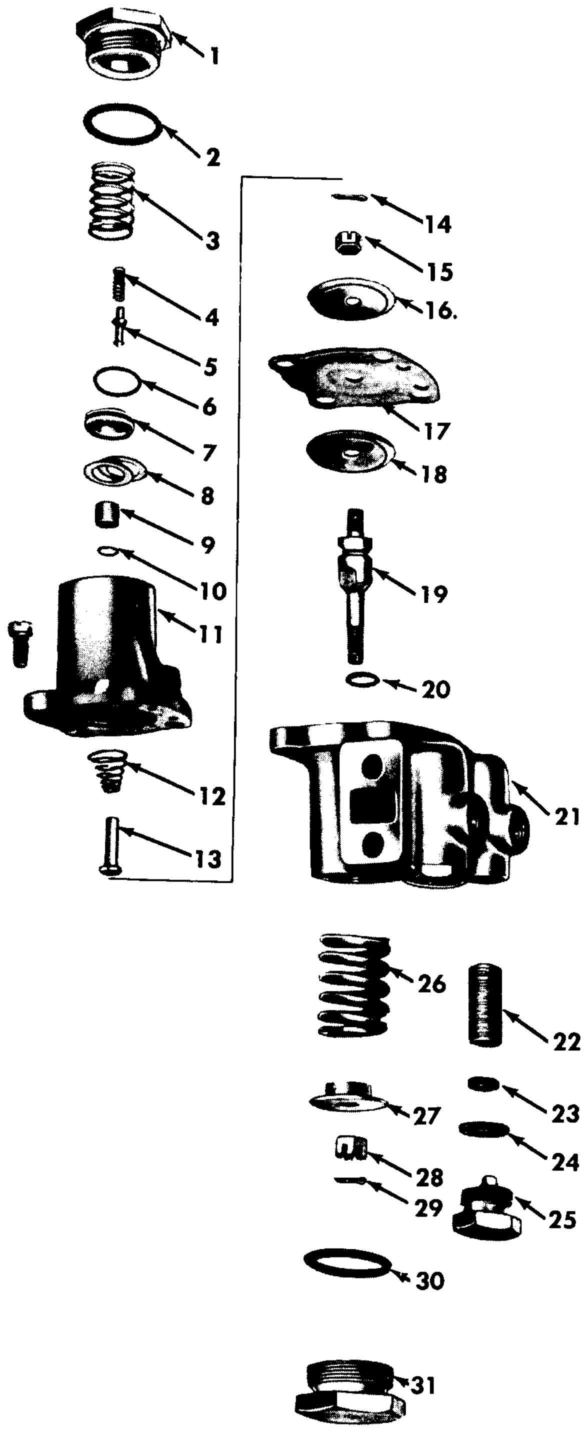
With governor in "cut-in" position, test for leakage at the inlet valve by applying soap suds to exhaust vent in valve body.

Leakage in excess of a 1-inch soap bubble in three seconds is not permissible in either of the above tests.

Coat the entire governor with soap suds to detect diaphragm, gasket, and cap screw leakage. No leakage is permissible.

GOVERNOR ADJUSTMENT

If necessary to adjust governor settings, remove spring cage screw cap, then remove cotter pin from diaphragm stem and adjusting nut. Pressure settings are raised by turning adjusting nut clockwise, and lowered by turning adjusting nut



1 Valve Body Screw Cap
2 Body Cap O-ring
3 Seat Retaining Spring
4 Inlet Valve Spring
5 Inlet-Exhaust Valve
6 Inlet Valve Seat O-ring
7 Inlet Valve Seat
8 Shims
9 Guide Bushing
10 Exhaust Stem O-ring
11 Valve Body
12 Exhaust Stem Spring
13 Exhaust Stem
14 Cotter Pin
15 Nut
16 Diaphragm Upper Follower
17 Diaphragm
18 Diaphragm Lower Follower
19 Diaphragm Stem
20 Diaphragm Stem O-ring
21 Spring Cage
22 Strainer
23 Felt Washer
24 Strainer Cap O-ring
25 Strainer Screw Cap
26 Pressure Setting Spring
27 Spring Seat
28 Adjusting Nut
29 Cotter Pin
30 Cage Cap O-ring
31 Spring Cage Screw Cap

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Figure 18—Governor Components

counterclockwise. Cotter pin must be replaced after adjustment. The range between the cut-out and cut-in setting is fixed at approximately 15 psi and cannot be adjusted.

GOVERNOR DISASSEMBLY

NOTE: Key numbers in text refer to figure 18.

1. Remove dirt and grease from outside of unit, using a brush and cleaning solvent.

AIR COMPRESSOR AND GOVERNOR

2. Remove valve body screw cap (1), then remove inlet valve spring (4), seat retaining spring (3), and inlet-exhaust valve (5). Remove O-ring (2) from screw cap.

3. Remove inlet valve seat (7), being careful not to damage inlet valve seating surface. Remove shims (8) from inlet valve seat bore in body. Remove O-ring (6) from valve seat.

4. Remove spring cage screw cap (31). Remove O-ring (30) from cap. Remove cotter pin (29) and adjusting nut (28) from diaphragm stem (19). Remove spring seat (27) and pressure setting spring (26).

5. Remove four cap screws attaching valve body (11) to spring cage (21). Separate valve body from spring cage. Remove exhaust stem (13) and spring (12) from body.

6. Remove diaphragm and stem assembly from spring cage. Remove cotter pin (14) and nut (15) from top of diaphragm stem, then remove diaphragm (17) and diaphragm followers (16 and 18) from diaphragm stem. Remove O-ring (20) from diaphragm stem.

7. Using a hooked tool, remove O-ring (10) from groove between guide bushing (9) and bore in valve body.

8. Remove two strainer screw caps (25), O-rings (24), felt washer (23), and strainers (22) from spring cage. Discard diaphragm, felt washers, and O-rings.

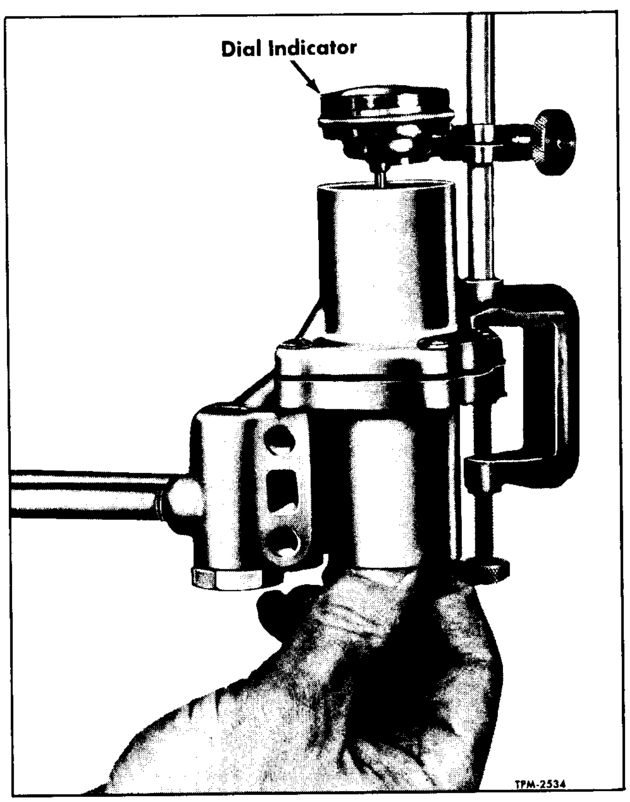


Figure 19—Checking Governor Valve Travel

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 18.

1. Clean all parts in cleaning solvent, making sure all air passages through valve body, spring cage, and exhaust stem are not obstructed in any way. Make sure air strainers (22) are thoroughly cleaned.

2. Inspect both seats on the inlet-exhaust valve (5) for grooves or damage. If either seat is grooved or damaged, replace inlet-exhaust valve.

3. Inspect inlet valve seat (7) for wear or damage. Replace seat if worn or damaged.

4. Inspect seat in upper end of exhaust stem (13). Replace stem if seat is worn or damaged. Also check fit of exhaust stem in valve body (11). Stem should be a neat sliding fit in body. Replace stem if excessively loose.

GOVERNOR ASSEMBLY

NOTE: Key numbers in text refer to figure 18. Refer to figure 17 for assembled view.

Apply thin coat of Lubriplate to exhaust stem, diaphragm stem, and all O-rings.

1. Install exhaust stem O-ring (10) in groove between guide bushing (9) and bore in valve body (11). Install exhaust stem spring (12) and exhaust stem (13) in body, being sure stem is a neat sliding fit in body.

2. Assemble diaphragm lower follower (18), diaphragm (17), and upper follower (16) on diaphragm stem (19), making sure beveled side of both followers are toward diaphragm. Install nut (15), tighten to 10-15 inch-pounds torque, and secure with cotter pin (14). Bend both legs of cotter pin toward the diaphragm.

3. Install O-ring (20) in groove in diaphragm stem (19). Install diaphragm and stem in spring cage (21), making sure stem is a neat sliding fit in bore in spring cage.

4. Assemble valve body on diaphragm and spring cage, making sure all air passages are aligned, and secure with four cap screws.

5. Install strainers (22), felt washers (23), and strainer screw caps (25) in bottom of spring cage, using strainer cap O-rings (24) in grooves in screw caps. Tighten screw caps firmly.

6. Measure total valve travel (fig. 19) by pulling diaphragm stem down as far as possible and setting dial indicator at zero when contacting top of exhaust stem. Push diaphragm stem completely in and read total valve travel on dial indicator. Total travel should be 0.060" to 0.098".

7. Install O-ring (6) in groove on inlet valve seat (7), then install inlet valve seat and inlet-exhaust valve. Repeat the above check starting with

the indicator zeroed on end of inlet-exhaust valve. Add or remove shims (8) under inlet valve seat until valve travel is within 0.030" to 0.040".

8. Install inlet valve seat retaining spring (3) and inlet valve spring (4). Install O-ring (2) on valve body screw cap (1) and thread screw cap into valve body. Tighten screw cap firmly.

9. Install pressure setting spring (26) and spring seat (27) on diaphragm stem in spring cage and secure with adjusting nut (28).

10. Mount governor on suitable test rack or on vehicle and connect air pressure source to port marked "RES." Leave spring cage screw cap (31) removed.

11. Build up pressure from zero and note pressure at which air starts to escape from spring cage. If less than 115 psi, turn adjusting nut clockwise; if above 120 psi, turn adjusting nut counterclockwise. After final adjustment, leakage should start at 115-120 psi. Secure adjusting nut (28) with cotter pin (29).

12. Install O-ring (30) in groove in spring cage screw cap (31) and thread cap into spring cage. Tighten firmly.

AIR COMPRESSOR AND GOVERNOR SPECIFICATIONS

AIR COMPRESSOR

Capacity (At 1250 RPM)	12 Cu. Ft.
Inlet Valve Seat	
Worn Groove Not to Exceed	0.003"
Discharge Valve Seat	
Worn Groove Not to Exceed	0.003"
Piston Ring Gap (In Cylinder)	0.005"-0.015"
Piston Ring Clearance (In Groove)	
Narrow Ring	0.002"-0.004"
Wide Ring	0.0035"-0.0055"
Clearance Between Piston and Cylinder Wall	0.002"-0.004"
Cylinder Bores	
Maximum Allowable Out-of-round	0.002"
Maximum Allowable Taper	0.003"
Crankshaft Seal Ring Gap (In Crankshaft)	0.008"-0.0015"
Crankshaft Journal Maximum Out-of-round	0.001"
Clearance Between Connecting Rod Bushing and Piston Pin (Ream)	0.0001"-0.0006"
Maximum Allowable Clearance	0.0015"
Discharge Valve Travel With New Valves, Springs, and Cap Nuts—Between	0.056"-0.070"
Clearance Between Connecting Rod Bearing and Crankshaft Journal (After Rebuild)	0.0003"-0.0021"
Inlet Valve Spring	
Free Height	29/64"
Height Under Load of	3/8" @ 2.7 oz. to 3.3 oz.
Discharge Valve Spring	
Free Height	1 7/64"
Height Under Load of	1.072" @ 1/4 lbs. to 3/4 lbs.
Unloader Valve Spring	
Free Height	3/4"
Height Under Load of	9/16" @ 5 lbs. 6 oz. to 6 lbs. 10 oz.

GOVERNOR

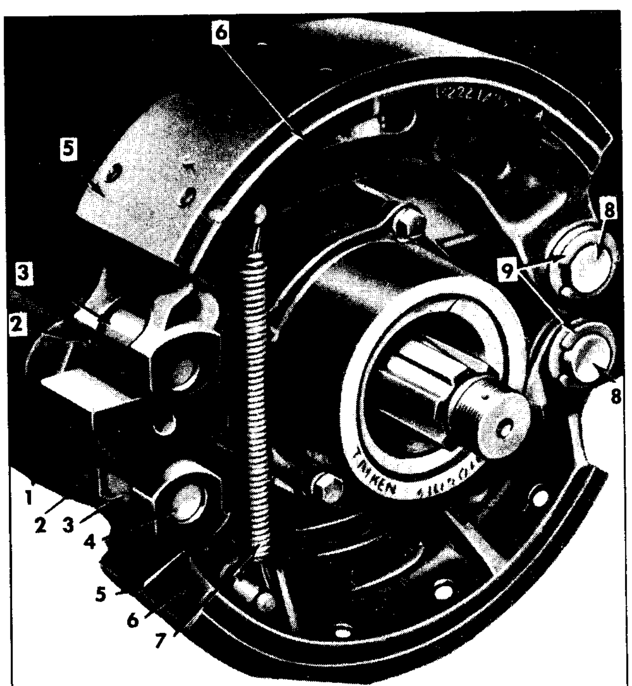
Make	Bendix-Westinghouse
Model	"D"
Cut-Out Pressure	115-120 psi
Cut-In Pressure	100-105 psi

Parking Brakes

Parking brake shoes are mounted on rear axle differential carrier housing as illustrated in figure 1. Parking brake is two-shoe, internal-expanding type. Brake lever is located at left side of driver. Parking brake lever is connected to an adjustable lever on brake camshaft by a series of rods and idler levers as shown in figure 2. Movement of brake lever rotates camshaft and forces brake shoes outward against brake drum. Brake drum is bolted to rear axle pinion companion flange.

PARKING BRAKE SHOES

Flanges on rear axle pinion bearing cage form the brake spider for brake shoes. Shoes pivot at one end on anchor pins which are retained in brake spider by lock screws and lock wire. Snap rings fit in grooves in ends of anchor pins to hold oil seal felts and retainers in place. Anchor pin ends of brake shoes are equipped with replaceable bushings. Cam end of each shoe is fitted with a roller which forms contact between brake shoes and cam. Roller pins for rollers are retained in shoes with set screws. One-piece lining is riveted to each brake shoe.



1 Camshaft
2 Set Screw
3 Roller
4 Roller Pin
5 Brake Lining
6 Brake Shoe
7 Brake Shoe Return Spring
8 Anchor Pin
9 Anchor Pin Lock

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Figure 1—Parking Brake Shoes Installed

PARKING BRAKE CAMSHAFT

Camshaft is mounted at one end in a bushing in differential carrier housing, and at the other end in a bushing in hand brake spider (pinion bearing cage). Lubrication fitting in differential carrier housing supplies lubricant to both bushings. Oil seal in brake spider prevents passage of lubricant into brake drum. Adjustable lever is retained on splined end of camshaft by a flat washer and snap ring.

PARKING BRAKE ADJUSTMENT

Adjustment for normal brake lining and drum wear is made with adjustable lever (fig. 3). Before adjusting brake, check the following linkage dimension: Two levers are located one above the other in a bracket on bulkhead near parking brake. Center of upper lever clevis pin (fig. 2) should be 2-31/32" away from bulkhead with brake in released position. To adjust this dimension, reposition end yoke at rear end of brake control rod.

1. Place parking brake lever in fully released position.
2. Clean all dirt and grease from adjustable lever.
3. Measure clearance between brake shoe lining and brake drum with feeler gauge.
4. If clearance exceeds 0.015" by an appreciable amount, turn adjustable lever adjusting bolt until clearance is reduced to 0.015".
5. Move brake lever to applied position. Movement of two or three notches from completely released position should be sufficient to give full parking brake application.

BRAKE SHOE REMOVAL

1. Remove nuts and lock washers attaching brake drum to drive pinion flange, then slide drum back on propeller shaft. (If necessary to remove brake drum, disconnect propeller shaft universal joint as directed in PROPLLER SHAFT (SEC. 18) in this manual.)
2. Remove brake shoe return spring.
3. Remove anchor pin locks, oil seal retainers, and oil seals from ends of anchor pins.
4. Cut lock wire, then loosen anchor pin set screws. Drive anchor pins out of brake spider and remove brake shoes.

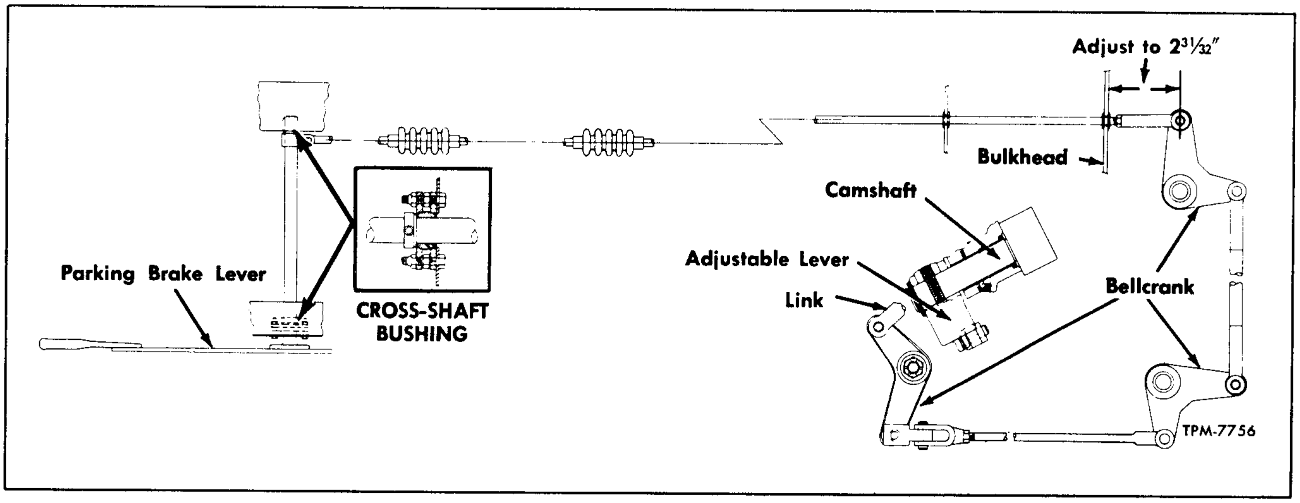


Figure 2—Parking Brake Control Linkage

BRAKE SHOE INSPECTION

1. Inspect brake lining and replace if worn down close to rivet heads. When making replacement, be sure brake lining fits firmly against brake shoe.
2. Examine anchor pin bushings in brake shoes and replace if worn excessively. After new bushings are installed, burnish to size listed in "Specifications" at end of this section.
3. Check brake shoe anchor pins for wear and replace if necessary.
4. Test brake shoe return spring for proper tension. Replace if weak or broken.
5. Examine rollers in brake shoes for wear or flat spots. Replace if not in good condition.
6. Inspect brake shoe contact surface of brake drum for wear, scoring, or out-of-round. Refinish or replace drum as required.

BRAKE SHOE INSTALLATION

1. Coat brake shoe anchor pins and bushings with grease.
2. Place brake shoes on brake spider and install anchor pins. Anchor pins must be installed with milled flats aligned with set screw holes in brake spider.
3. Install new oil seals, seal retainers, and new anchor pin locks on ends of anchor pins. Install anchor pin set screws and tighten firmly; then wire set screw heads together.
4. Install brake shoe return spring. Coat cam and brake shoe rollers sparingly with chassis grease.
5. If propeller shaft was disconnected, place brake drum over propeller shaft, then assemble universal joint as directed in PROPELLER SHAFT (SEC. 18) of this manual.
6. Position brake drum on studs on drive pinion flange and secure with lock washers and nuts. Tighten nuts firmly.
7. Adjust brake as previously directed under "Parking Brake Adjustment" in this section.

CAMSHAFT REMOVAL

If necessary to remove camshaft, follow instructions previously given in steps 1 and 2 under "Brake Shoe Removal," then proceed as follows:

1. Remove propeller shaft flange from differential pinion shaft.
2. Disconnect link assembly from adjustable lever. Remove snap ring and washers securing adjustable lever on camshaft; then slide lever off camshaft.

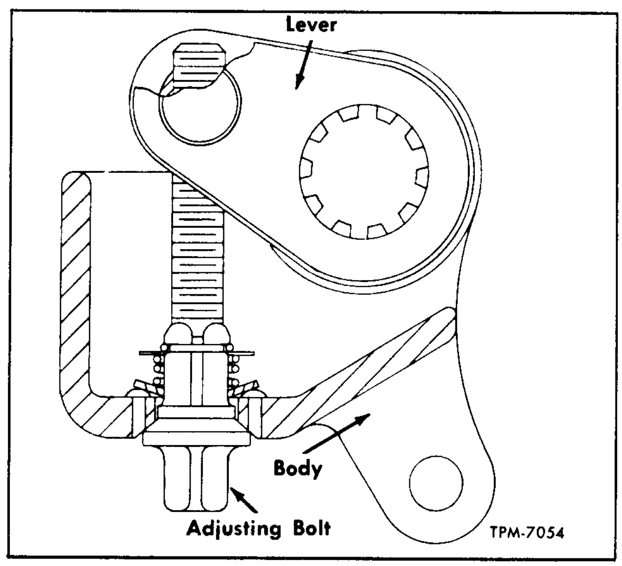


Figure 3—Parking Brake Adjustable Lever

PARKING BRAKE

3. Pull camshaft straight out through brake spider. Do not lose spacing washer used between adjustable lever and differential carrier housing.

CAMSHAFT INSPECTION

1. Examine camshaft bushings in brake spider (pinion bearing cage) and in differential carrier housing. If worn excessively, install new bushings. After installing new camshaft bushings, burnish to correct size shown in "Specifications" at end of this section.

2. Inspect camshaft oil seal in brake spider and replace if wear or deterioration is evident. When installing new oil seal, lip of seal must point inward toward bushing.

3. Examine camshaft and replace with new part if cam is scored or worn, or if shaft diameter is appreciably less than original diameter.

CAMSHAFT INSTALLATION

1. Coat camshaft and camshaft bushings with grease.
2. Insert splined end of camshaft through brake spider and differential carrier housing; be careful not to damage camshaft bushings or oil seal in brake spider.
3. Position brake shoes against cam; then install brake shoe return spring.
4. Make sure camshaft is turned so brake shoe rollers are resting on low points on cam. Place spacing washer over splined end of camshaft.
5. Place adjustable lever on camshaft in the position which will permit connecting the link with least possible movement of camshaft.
6. Install washers and snap ring to secure adjustable lever on camshaft. Coat cam and brake shoe rollers sparingly with graphite grease.
7. Connect link assembly to adjustable lever. Install companion flange on differential pinion shaft.
8. Install brake drum and propeller shaft as directed in applicable steps under "Propeller Shaft Installation" in PROPELLER SHAFT (SEC. 18) of this manual.
9. Adjust brake as previously directed under "Parking Brake Adjustment" in this section.

PARKING BRAKE LINKAGE
(Refer to Figure 2)

Parking brake lever, located to left of driver, is attached to outer end of cross shaft. Cross shaft is solid and is supported at each end in permanently lubricated, self-aligning, bushing type bearings. Inner end of cross shaft carries a lever to which the front end of brake rod is connected. Brake rod incorporates spring type dampers and is connected to bell crank mounted on rear axle differential carrier housing. Bell crank is connected to an adjustable lever on camshaft by a link and pins. Lubrication fittings are provided for idler levers and hand brake bell cranks. All other moving parts should be lubricated with oil can.

LUBRICATION

Periodic lubrication is required at the following points: Camshaft, brake shoe rollers and cam, bell crank, idler levers, hand lever, and all clevis connections in brake linkage. Refer to LUBRICATION (SEC. 13) for recommended intervals, type of lubricant, and method of application. Anchor pins require lubrication only at installation, using lubricant specified in LUBRICATION (SEC. 13).

PARKING BRAKE SPECIFICATIONS

Type	Two-Shoe Internal-Expanding
Location	On Rear Axle Differential Carrier
Brake Drum Inside Diameter	12″
Shoe Lining	
Length (Each shoe)	11½″
Width	4½″
Thickness	½″
Area (both shoes)	104 sq. in.
Brake Shoe Return Spring	
Free Length	7″
Length at 27-33 Lbs. Pull	7¹¹⁄₁₆″
Cam Roller In Shoe	
Roller Outside Diameter	1.248″-1.252″
Roller Inside Diameter	0.771″-0.776″
Roller Pin Diameter	0.748″-0.749″
Camshaft and Bushings	
Shaft Diameter (at Bushings)	1.243″-1.245″
Bushing Inside Diameter (burnish in place)	
In Brake Spider	1.249″-1.251″
In Differential Carrier Housing	1.249″-1.251″
Anchor Pins and Bushings	
Pin Diameter (at Bushings)	0.996″-0.994″
Pin Length	2⅞″
Bushing Diameter	
Inside (burnish)	0.998″-1.000″
Outside	Must Be Tight in Shoe
Bushing Length	0.470″-0.490″
Diameter of Hole in Shoe	1.0615″-1.0630″

Clutch and Controls

DESCRIPTION

Clutch is two-plate dry disc type, illustrated in figures 1 and 7. An intermediate (center) drive plate is installed between the two discs, the hubs of which are splined to transmission drive gear. Coil springs between clutch cover and pressure plate provide positive engagement of clutch members. Springs exert pressure on pressure plate, and hence to rear driven disc, intermediate driving plate, forward driven disc, and flywheel face.

Figures 2 and 3 show the clutch release mechanism. Clutch release is affected by pedal pressure which actuates air valve in engine compartment to admit air pressure into air cylinder, which assists in releasing clutch. Release mechanism in clutch housing consists of a yoke installed on cross shaft and clutch release bearing and support assembly (fig. 8).

OPERATION OF AIR-ASSISTED CLUTCH RELEASE MECHANISM

Key numbers in text refer to figure 4 unless otherwise indicated.

Initial movement of clutch pedal exerts pull on rod (1), and since there is no resistance to movement of lever (20), the lever moves until release bearing contacts clutch release levers (32, fig. 7).

With release bearing against clutch release levers, the pull on rod (1) is increased as clutch pedal is depressed further. When the pull on rod (1) exceeds 40 pounds, the pull rod and lever in valve (4) are moved and actuate piston, which in turn closes exhaust valve and begins to open air inlet valve.

With inlet valve open in control valve (4), air from supply line (6) passes into line (5) and into air cylinder (11). Air pressure acting on cylinder piston exerts pressure through piston rod, clevis, and clevis pin (19) which connects clevis to release lever (20). Since air cylinder is anchored to stationary bracket (15), piston continues to assist in movement of release lever (20) so long as a pull in excess of 40 pounds is applied through rod (1). As cylinder piston rod moves outward, air ahead of piston is exhausted through breather (10).

As soon as the air pressure in cavity beside the valve piston and in cylinder (11) is sufficient to overcome the mechanical force which is applied to valve piston by actuating lever, the piston moves toward actuating lever and permits air inlet valve to seat. This prevents any additional rise in air pressure in cylinder, and since the exhaust valve remains closed, the air pressure remains stable in cylinder and clutch linkage remains stationary.

When driver wishes to engage clutch and clutch pedal is released, the reduced pull on rod (1) causes a reduction in mechanical force acting on valve piston, consequently the air pressure in cylinder and at piston forces piston back to released position, at which time the exhaust valve is opened and air pressure in cylinder (11) is released. Clutch spring pressure moves pressure plate into engagement with driven members, at the same time release lever (20) moves toward cylinder (11), exhausting air from cylinder through air line (5) and out exhaust port (2) in side of valve (4). As piston is forced into cylinder (11), atmosphere enters cylinder through breather (10).

Spring (16) holds lever (20) in contact with wedge-shaped end on adjusting nut (7) and causes release bearing to be held out of contact with clutch release levers. Spring (9) supports air line (5) so it does not rub against other mechanism. Pedal return spring (7, fig. 3) holds pedal and linkage in released position when driver's foot is not on pedal.

CLUTCH CONTROL MAINTENANCE

CLUTCH PEDAL AND LINKAGE (Fig. 3)

1. Be sure all pivot points in control linkage are lubricated according to instructions given in LUBRICATION (SEC. 13).

2. Check dimension between clutch pedal lever (3) and underside of floor. If necessary to provide the 4-1/2 inch dimension as shown, move the adjustable collar (2) which is held in place by set screw.

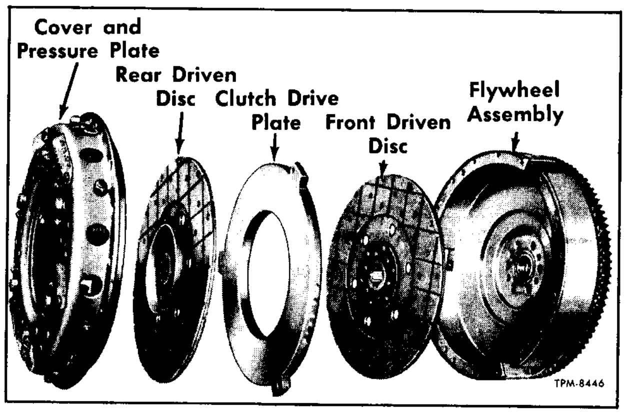
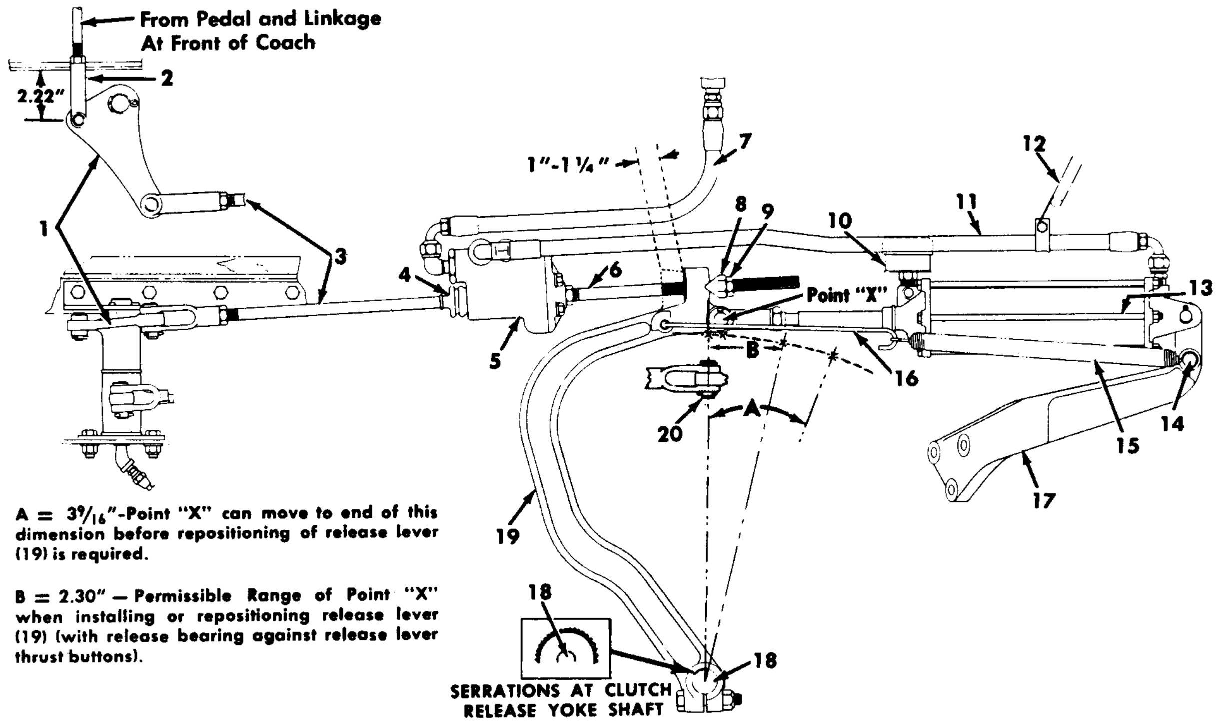


Figure 1—Clutch Components

CLUTCH AND CONTROLS



1 Clutch Control Bell Crank
2 Adjustable Clevis
3 Lever-to-Valve Rod
4 Valve Rod Boot
5 Air Control Valve
6 Valve-to-Lever Rod
7 Air Supply Line
8 Clutch Adjusting Nut
9 Lock Nut
10 Air Cylinder Breather
11 Valve-to-Cylinder Air Line
12 Spring
13 Air Cylinder
14 Spring Anchor
15 Clutch Lever Spring
16 Spring Extension
17 Air Cylinder Bracket
18 Clutch Release Yoke Shaft
19 Clutch Release Lever
20 Transmission Lever Clevis Pin

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Figure 2—Clutch Control Linkage (in Engine Compartment)

3. Always use return spring (7) as specified in Parts Book.

4. When replacing control rod (8), rod end clevises or bell crank (15), adjust rod end clevises so that center of pin hole in bell crank (15) is distance from bulkhead shown in figure 2. This will give best leverage for disengaging clutch with light pedal pressure.

CAUTION: Always make adjustments as later described at linkage in engine compartment after replacing any items shown in figure 2.

CONTROL LINKAGE AND UNITS IN ENGINE COMPARTMENT (Fig. 2)

1. Make periodic inspection of air lines and air line connections.

2. Check lock nut on rod (6) at air valve (5). Lock nut must be kept tight to hold valve in position. There must be no twisting force on control valve plunger in either the engaged or disengaged position.

3. Lubricate pivot points in linkage as directed in LUBRICATION (SEC. 13).

4. At intervals specified on Lubrication Chart, remove pipe plugs (12, fig. 4) from both ends of air cylinder and introduce one ounce of engine oil into each end of cylinder. Refer to LUBRICATION (SEC. 13) for correct type and viscosity of oil to use.

5. At 50,000 mile intervals remove and discard air cylinder breather (10, fig. 4) and install new breather assembly.

6. On early vehicles only, make periodic inspection of piston rod boot. The vent hole in boot must be at bottom and boot must fit tight enough at cylinder and rod to seal against dirt and moisture.

7. Lubricate clutch release bearing and yoke shaft fittings in clutch housing as directed in LUBRICATION (SEC. 13) in this manual. Figure 8 shows clutch release mechanism in clutch housing.

8. Apply S.A.E. 10W engine oil at oiler (22,

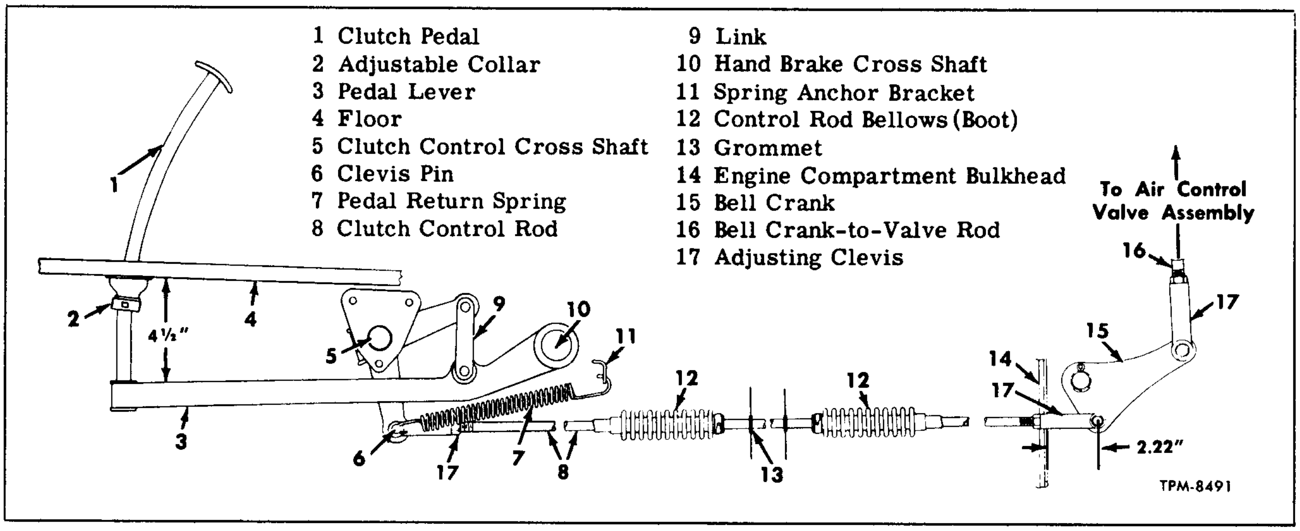


Figure 3—Clutch Control Linkage (Pedal To Rear Bulkhead)

fig. 4) on valve assembly at intervals specified in LUBRICATION (SEC. 13).

CLUTCH CONTROL ADJUSTMENTS

RELEASE BEARING CLEARANCE ADJUSTMENT

Adjustment to compensate for normal clutch facing wear is made at the clutch release lever in engine compartment. This adjustment must be made when inspection indicates need for adjustment. The 1 to 1-1/4 inch free movement of release lever (fig. 2) must be maintained to assure clearance between release bearing and thrust buttons on clutch release levers, and to provide full disengagement of clutch when clutch pedal is near floor.

Check and make adjustment as follows:

Key numbers in text refer to figure 2.

1. Unhook clutch lever spring (15).
2. Move lever (19) from point of contact with wedged end of nut (8) toward control valve (5). If lever free movement is not within the 1 to 1-1/4-inch range shown in figure 2, make adjustment as instructed in step 3. below. Adjustment should be maintained as closely as possible within this range to provide ideal clutch operation.
3. Loosen lock nut (9), and turn adjusting nut (8) as necessary to provide 1 to 1-1/4 inches free-travel of lever (19). Be sure wedge end of adjusting nut (8) is aligned with V-notch in release lever (19), then tighten lock nut. After tightening lock nut, recheck control valve for binding both in the engaged and disengaged positions. There must be no twisting force on valve plunger.
4. When adjustment is completed, install release lever spring and extension (15 and 16).

CAUTION: DO NOT use a substitute for spring (15) with tension greater than original spring. Also be sure extension (16) is not shorter than original part. Increasing the tension of spring will hold exhaust valve in control valve closed and trap air in air cylinder.

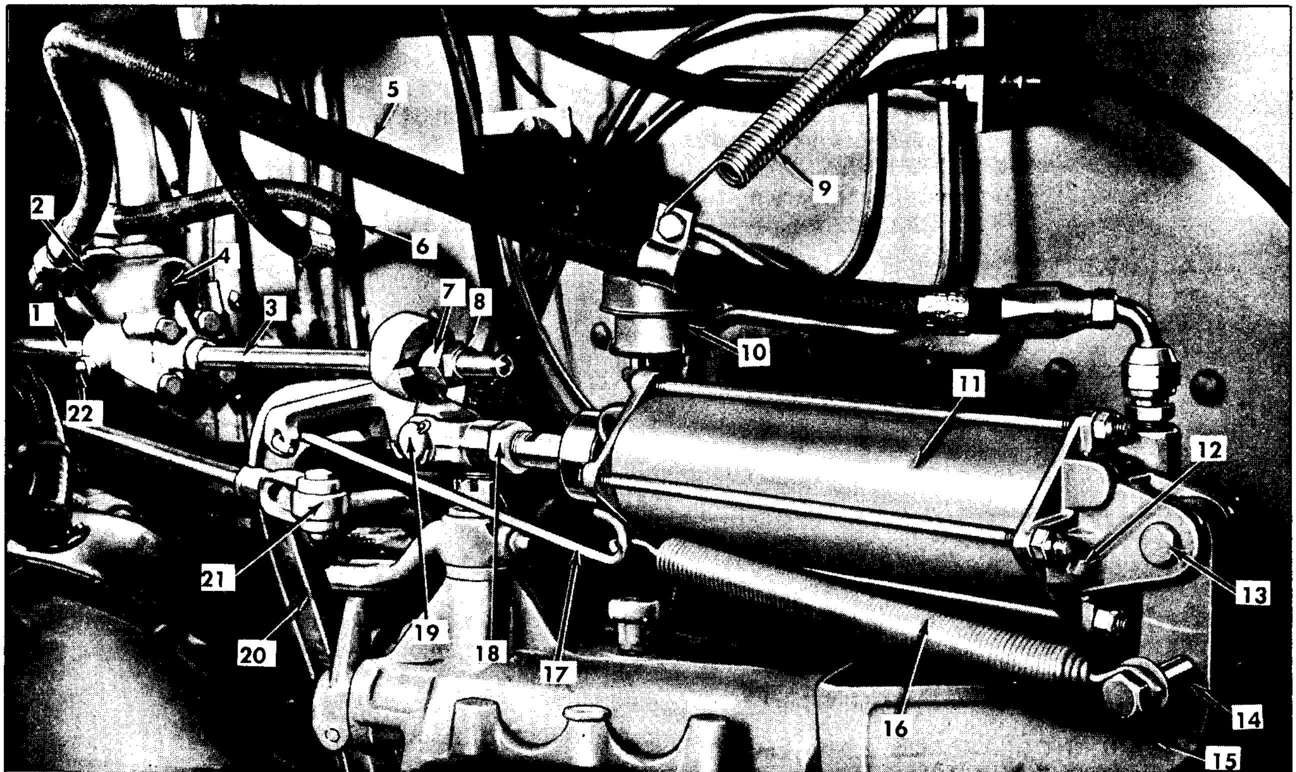
REPOSITIONING RELEASE LEVER

As clutch facings wear, point "X" (fig. 2) normally moves toward air cylinder (13) with each succeeding release bearing clearance adjustment. This point, which is the centerline of clevis pin attaching air cylinder clevis to release lever, must be within the dimension shown for "A" in figure 2 when clutch is engaged. To determine if lever (19) should be repositioned, shift transmission to neutral, then measure distance from center of clevis pin (20, fig. 2) to point "X" when clutch is engaged. If the distance is more than 3-9/16 inches, release lever must be repositioned on release yoke shaft (18, fig. 2) as follows:

Key numbers refer to figure 2 unless otherwise indicated.

1. Place transmission gearshift lever in neutral, and unhook release lever return spring (15). Remove clevis pin which attaches clevis to release lever at point "X" and disengage clevis from lever (19).
2. Loosen clamp bolt securing release lever (19) to shaft (18), and mark lever (19) and end of shaft (18) to show original relationship.
3. Pry release lever (19) off shaft (18), move top of lever toward air control valve (5) one serration from original position as marked in step 2, and reinstall lever on shaft.
4. Check position of point "X" which must be within the dimension shown for "B" in figure 2, with release bearing contacting clutch release lever thrust buttons. Tighten release lever clamp bolt to 35 to 45 foot-pounds torque. Connect air cylinder rod clevis to release lever (19) with

CLUTCH AND CONTROLS



1 Clutch Release Rod	9 Spring	16 Clutch Lever Spring
2 Valve Exhaust Port	10 Air Cylinder Breather	17 Spring Extension
3 Valve-to-Lever Rod	11 Air Cylinder	18 Lock Nut
4 Air Control Valve	12 Lubrication Plug	19 Piston Rod Clevis Pin
5 Valve-to-Cylinder Air Line	13 Pin	20 Clutch Release Lever
6 Air Supply Line	14 Spring Anchor	21 1, 2, and Reverse Shift Lever
7 Adjusting Nut	15 Air Cylinder Bracket	22 Oiler TPM-8738
8 Lock Nut		

Figure 4—Clutch Air Cylinder and Control Valve Installed

clevis pin and cotter pin.

5. Adjust release bearing clearance as previously instructed.

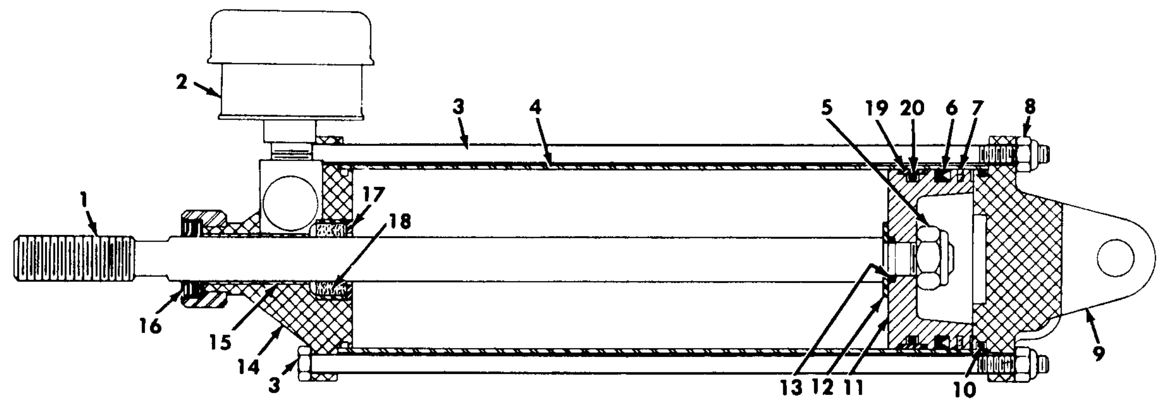
NOTE: Release lever (19) cannot repeatedly be repositioned. After lever has been repositioned once and normal wear has permitted point "X" to reach maximum limit as shown for dimension "A" on figure 2, it must be determined whether there is sufficient clearance between the clutch release levers (32, fig. 7) and clutch cover (12, fig. 7) to warrant repositioning lever again. This can be checked through opening in clutch housing after removing louvered covers (14, fig. 7) from housing. If clearance is less than 3/16 inch, new clutch disc and facing assemblies must be installed. After installing new facings, release lever will require repositioning toward air cylinder (13) to bring point "X" within the dimension shown for "B" on figure 2.

PEDAL AND LINKAGE ADJUSTMENT

Proper position of clutch pedal at front end of coach and bell crank at engine compartment bulkhead are necessary to provide correct leverage to operate release mechanism. These adjustments are not normally required except when linkage components are replaced, or when unsatisfactory clutch operation indicates need for adjustment. The need for adjustment could be the result of wear at clevis pins, bushings or improper location of adjustable collar (2, fig. 3).

Key numbers in text refer to figure 3 unless otherwise indicated.

1. In tool compartment (door at left front corner of coach) measure distance from pedal lever (3) to floor. If necessary, relocate adjustable collar (2) to provide the 4-1/2 inch dimension shown.
2. Check the pedal return spring for proper installation, then in engine compartment, measure



1 Piston Rod	8 Nut	15 Bushing
2 Breather Assembly	9 Rear Cover	16 Piston Rod Seal
3 Clamp Bolt	10 O-Ring Gasket	17 Felt Retainer
4 Cylinder	11 Piston	18 Felt
5 Piston Retaining Nut	12 Washer	19 Wiper
6 Piston Seal Ring	13 O-Ring Seal	20 O-Ring
7 Piston Felt	14 Front Cover	

Figure 5—Cross Section of Clutch Release Air Cylinder Assembly

distance from rear side of bulkhead to center of clutch rod clevis pin. Dimension must be 2.22 inches. If necessary to make a change to provide the 2.22 inch setting, remove clevis pin (6) from clevis in tool compartment, loosen lock nut and thread clevis (17) as required to shorten or lengthen rod (8). When correct dimension is obtained, install clevis pin (6), hook up spring (7) and tighten lock nut at clevis.

3. Make release bearing clearance adjustment as previously directed.

CLUTCH RELEASE AIR CYLINDER

REMOVAL (Refer to Fig. 4)

1. Unhook and remove release lever return spring (16).
2. Disconnect air line (5) at air cylinder (11).
3. Remove pin (19) which attaches piston rod clevis to clutch release lever (20).
4. Remove pin (13) which attaches air cylinder assembly (11) to bracket (15), then remove cylinder assembly.
5. Remove yoke, lock nut, and boot (when used) from piston rod and cylinder.

DISASSEMBLY (Refer to Fig. 5)

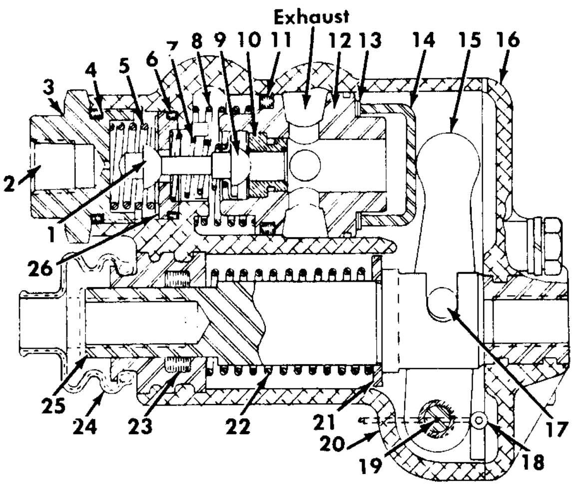
1. Remove breather assembly (2) from cylinder front cover.
2. Remove nuts (8) from bolts (3) and remove bolts.
3. Remove end covers (9 and 14) and pull piston and rod assembly out of cylinder (4).
4. Remove O-ring (10) from rear cover (9). Pry seal retainer off front cover and remove piston rod seal (16). On late type, remove felt retainer (17) and felt (18) from inner side of cover.
5. Remove piston felt (7) and seal ring (6) from piston (11). On late type, remove wiper (19) and O-ring (20) from piston (11).
6. To remove piston (11) from piston rod (1), clamp rod in vise at flat areas and remove self-locking nut (5). Remove piston and O-ring (13) from rod, then remove washer (12).

CLEANING AND INSPECTION

Clean all parts thoroughly, then inspect each component carefully. If any of the parts are damaged, install new ones when assembling. A repair kit containing parts usually requiring replacement is available when overhauling air cylinder assembly.

ASSEMBLY (Refer to Fig. 5)

1. If piston has been removed from piston rod, grip rod (1) in vise at flat areas, then place washer (12) against shoulder on rod.
2. Locate O-ring (13) in counterbore in piston (11), then install piston on rod and install retaining nut (5). Tighten nut firmly. Install piston felt (7), and install seal ring (6) with lip toward felt (7). On late type, install O-ring (20) and wiper (19) on piston (11).
3. Install piston rod seal (16) and retainer on front end cover (14); On late type, install felt (18) and retainer (17) in inner side of front end cover.



1	Inlet Valve	14	Piston Seat
2	Air Supply Inlet Port	15	Actuating Lever
3	Inlet Valve Cap	16	Cover
4	Seal	17	Lever Pin
5	Retainer Spring	18	Cotter Pin
6	Valve Seal Seat	19	Fulcrum Pin
7	Valve Spring	20	Valve Body
8	Piston Spring	21	Washer
9	Exhaust Valve	22	Pull Rod Spring
10	Exhaust Valve Seat	23	Oiler Felt
11	Piston O-Ring Seal	24	Boot
12	Piston	25	Pull Rod
13	Shims	26	Spring Seat

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Figure 6—Cross Section of Air Control Valve

Place O-ring (10) in groove in rear cover. Apply a light coat of Lubriplate or equivalent on piston rod. Apply S.A.E. 10W engine oil on piston and inner surface of cylinder.

4. Insert piston rod through cylinder and carefully pull piston into cylinder. Be sure to guide seal ring and felt (6 and 7) (and wiper on late type) into cylinder without damage to these parts.

5. Install front and rear covers (14 and 9) on cylinder and install four clamp bolts and nuts (3 and 8).

NOTE: Threaded openings in both covers must face upward.

6. Remove pipe plug from rear cover (9) and put in one ounce of S.A.E. 10W engine oil. Install plug, then while turning cylinder, operate piston several times by hand to distribute oil evenly over all inner surfaces.

7. Bench test cylinder assembly for air leaks. Test can be made by connecting air supply at tapped hole in rear cover (9) and checking for air bubbles at breather port in front cover (14), and at end of cylinder where it seats at rear cover, with air pressure applied. Do not use air pressure in excess of 100 psi for testing. Use soap suds solution and brush.

8. Install breather assembly (2) in front cover.

INSTALLATION (Refer to Fig. 4)

1. Install boot (when used) on cylinder and locate vent hole toward bottom. Install lock nut and yoke.

2. Locate air cylinder assembly (11) at bracket (15) and install pin (13). Secure pin (13) with cotter pin.

3. Attach piston rod yoke to release lever (20) with clevis pin (19).

4. Connect air line (5) to fitting in rear cover.

5. Check clutch release linkage adjustments as previously directed under "Clutch Control Adjustments."

6. Install release lever return spring (16) and extension (17).

AIR CONTROL VALVE

REMOVAL

Key numbers in text refer to figure 4 unless otherwise indicated.

1. Exhaust air pressure from air system.

2. Disconnect and remove air lines (5 and 6).

3. Unhook and remove release lever return spring (16) and extension (17).

4. Disconnect bellcrank to control valve rod (1) from bellcrank (1, fig. 2). Remove lock nut (8) and adjusting nut (7) from control valve to release lever rod (3). Remove valve and rods as an assembly.

5. Unscrew rods (1 and 3) from control valve.

6. Remove boot used to seal out dust and moisture at rod (1).

DISASSEMBLY

Key numbers in text refer to figure 6 unless otherwise indicated.

1. Remove snap ring from exhaust port (2, fig. 4), then remove cleaning material and retaining plates. Remove oiler (22, fig. 4) from valve body.

2. Remove end cover bolts, then remove end cover (16). Remove fulcrum pin (19) which is retained by cotter pin (18), then remove actuating lever (15) and pull rod (25).

3. Remove spring (22) and spring washer (21) from pull rod.

4. Remove piston seat (14) and shims (13).

5. Use wrench to remove inlet valve cap (3), then remove springs, spring seat, and valves (1 and 9).

6. Use a round rod to push piston assembly (12) out of body (19). Remove O-ring seal (11) from piston.

CLEANING AND INSPECTION

Thoroughly wash all parts of valve in cleaning

solvent to remove all deposits of dirt.

Inspect each valve component for wear, corrosion, and other damage. Exhaust valve seat in piston must be in good condition.

ASSEMBLY

Key numbers in text refer to figure 6 unless otherwise indicated.

1. Using new seals (4 and 6) on inlet valve cap and inlet valve assembly (3 and 1), assemble valve assembly (1), spring (5), and cap (3) in valve body.

2. Install new piston O-ring seal (11) on piston (12), then place piston spring (8) in body (20). Lubricate piston O-ring (11) and piston bore with light coat of Lubriplate and insert piston assembly into body.

3. Oil the felt (23) with engine oil, then with spring washer and spring (21 and 22) on pull rod (25), assemble pull rod in body (20).

4. Place piston seat (14) on piston and temporarily install lever (15) in body with pin (17) engaged with notch in pull rod (25). Install fulcrum pin (19).

5. Install a stop plate across end of body using two cover bolts. (Plate to serve to locate pull rod in normal operating position). Connect an air supply line to air supply inlet port (2), and mount a dial indicator to measure distance piston seat (14) travels from released position to point at which inlet valve (1) opens. Opening of inlet valve will be indicated by sound of air at air delivery port. If indicator shows movement in excess of 0.030 inch, remove piston seat (14) and install shims (13) as required to reduce movement to 0.020 to 0.030 inch.

6. After shim selection is made, assemble cover (16) on valve body (20).

7. Install oiler (22, fig. 4) and install filter in exhaust port (2, fig. 4).

INSTALLATION

Key numbers in text refer to figure 4 unless otherwise indicated.

1. Place dust boot (24, fig. 6) on valve body, then screw rods (1 and 3) into control valve. A lock nut must be in place on rod (3) which is installed in th cover end of the valve.

2. Position valve and rod assembly at engine with rod (3) inserted through upper end of clutch release lever (20). Connect rod (1) at bellcrank (1, fig. 2).

3. Install adjusting nut (7) on rod (3). While holding lever (20) toward valve (4) to locate release bearing in contact with clutch levers, thread nut (7) to provide 1 to 1-1/4 inches between point of nut wedge and bottom of Vee in lever (20). Install spring (16) and extension (17), then install and tighten lock nut (8).

4. Connect air lines (5 and 6). Start engine and operate to build up pressure in air system. Perform tests described below after control valve is installed.

CONTROL VALVE LEAKAGE TEST (Fig. 4)

With air system charged to normal operating pressure, coat exhaust port (2) with soap suds and check for leakage. The check should be made both with the clutch released and with clutch engaged. If a three inch bubble forms in three seconds or less, leakage is excessive. Excessive leakage is caused by defective valves and/or valve seats, or air passing the piston O-ring seal.

CONTROL VALVE OPERATING TEST (Fig. 4)

Disconnect line (5) from valve (4) and install an air pressure gauge to register pressure at valve outlet port. Observe gauge as clutch pedal is depressed. Pressure on gauge should gradually increase as pedal force increases when pedal is moved from "Clutch Engaged" to "Clutch Disengaged" position.

CLUTCH REMOVAL

Key numbers in text refer to figure 7.

Before removing clutch, transmission must be removed as instructed in TRANSMISSION (SEC. 17). Then proceed as follows:

1. Install six bolts (cap screws -3/8"-16 x 2", threaded 1") through holes in cover plate (12) located directly above each release lever (32). Turn screws into pressure plate (9) as far as possible. This procedure relieves pressure spring (11) load so cap screws (35) can be easily removed.

2. Install aligning arbor (fig. 10) or old clutch shaft to support driven disc when removing clutch cover assembly.

3. Remove cover bolts (35), meanwhile supporting clutch. Tap flange of clutch cover with soft mallet to free assembly from flywheel. Remove clutch cover assembly, driven discs, and drive plate (8).

4. To remove pilot bearing (40), flywheel bolts (39) must be first removed as pilot bearing is retained by bearing retainer (3) which also serves as bearing plate for flywheel bolts. Remove flywheel and drive out pilot bearing assembly (40).

NOTE: If inspection shows flywheel plate (6) to be worn or damaged, the plate may be removed by removing twelve bolts (5) which attach plate (6) to flywheel (7). Refer to figure 1 for view of clutch components.

RELEASE MECHANISM REMOVAL (Fig. 8)

1. Remove release lever from clutch release yoke shaft. Remove cover plate from housing at opposite end of shaft.

2. Remove two springs (2) connecting release bearing sleeve to release yoke (10). Disconnect lubrication tube (5) from release bearing sleeve, then slide bearing and sleeve assembly (1) off end of transmission bearing cap (4).

3. Remove two cap screws (9) from release yoke, then drive the yoke to one side to expose keys (6). Remove yoke keys and drive shaft out of yoke and remove from housing.

CLUTCH INSTALLATION

RELEASE MECHANISM INSTALLATION

Key letters in text refer to figure 8.

1. Hold clutch release yoke (10) in position in clutch housing (12), then insert release shaft (8) through right-hand bushing (11), through yoke (10), and into bushing at opposite side of clutch housing.

2. Install keys (6) in shaft (8), and move yoke

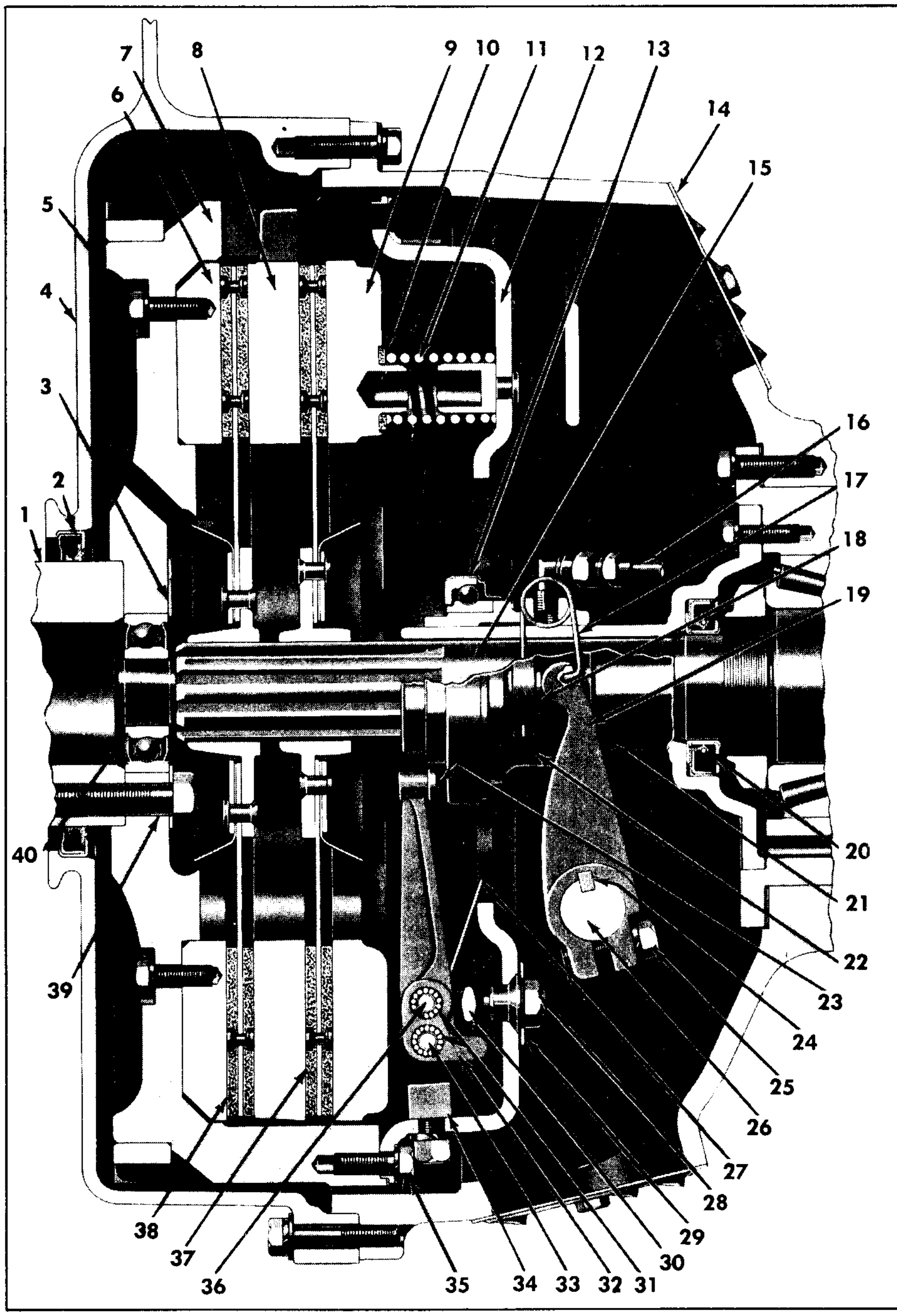
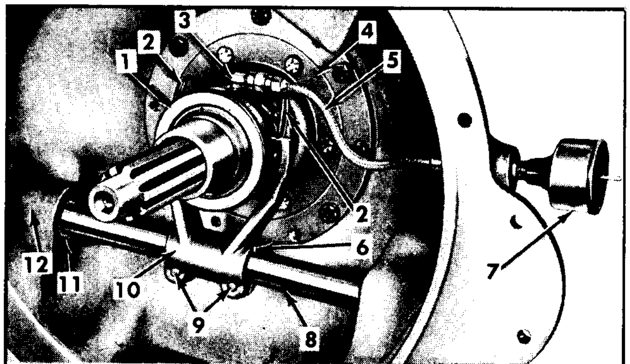


Figure 7—Cross Section of Clutch Installed



1 Release Bearing and Support Assembly	6 Yoke Key
2 Release Bearing Spring	7 Grease Cup
3 Lubrication Elbow	8 Release Lever Shaft
4 Transmission Bearing Cap	9 Yoke Clamp Bolts
	10 Release Yoke
	11 Bushing
5 Lubrication Flexible Tube	12 Clutch Housing

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Figure 8—Release Mechanism In Clutch Housing

into place with keys (6) engaging keyway in yoke. Do not tighten bolts (9) until after release bearing and support assembly (1) is assembled to bearing cap (4).

3. Install shaft cover plate at outer side of housing (12). Rotate shaft (8) so yoke (10) is in position shown in figure 8, install release bearing and support assembly (1) on bearing cap (4), and clip support to yoke with two release bearing springs (2). Connect lubrication flexible tube (5) to release bearing support.

4. Check shaft (8) and yoke (10) to make sure they are properly centered, then tighten yoke clamp bolts (9).

5. Fill grease cup (7) with lubricant as specified in LUBRICATION (SEC. 13) and turn down cup to provide initial lubrication to bearing assembly. Apply a light coat of same lubricant on pilot surface on bearing cap (4). Also lubricate shaft bushings (11) through respective fittings.

FLYWHEEL, COVER PLATE, AND DRIVEN DISCS

Key numbers in text refer to figure 7 unless otherwise indicated.

1. If flywheel and/or pilot bearing have been removed, fill crankshaft cavity 1/3 full of pilot bearing lubricant - (high melting point 300°F. sodium soap grease).

2. Install pilot bearing (40) in flywheel (7), then install flywheel on crankshaft with holes for bolts (39) aligned. Place bearing retainer (3) at flywheel and install flywheel bolts. Tighten bolts evenly to 150 to 160 foot-pounds torque.

3. Refer to figure 9 and place clutch disc marked "Flywheel Side" at flywheel.

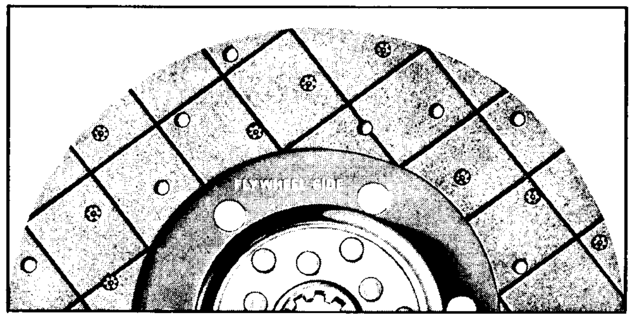


Figure 9—Clutch Disc Identification Marking

CAUTION: The two driven discs are not interchangeable. Disc hubs can be referred to for identification if markings are not legible. Rear disc assembly is marked "Pressure Plate Side." Slinger on front disc (38) must be toward flywheel and the slinger on rear disc (37) must be toward release bearing (13).

4. Place drive (center) plate (8) in position at front driven disc.

NOTE: Install drive plate (8) with machined side of drive lugs toward transmission.

5. Locate rear driven disc (37) at plate (8), referring to "CAUTION" note above for correct identification of rear disc and proper position of slinger. Insert aligning arbor through driven disc hubs and into pilot bearing (40) to hold disc splines in alignment while cover assembly is being installed. Refer to figure 10.

6. Place clutch cover assembly at flywheel, then install cover bolts (35) with new lock washers. Tighten bolts evenly and firmly.

7. If new clutch cover and pressure plate assembly is being installed, remove the six bolts

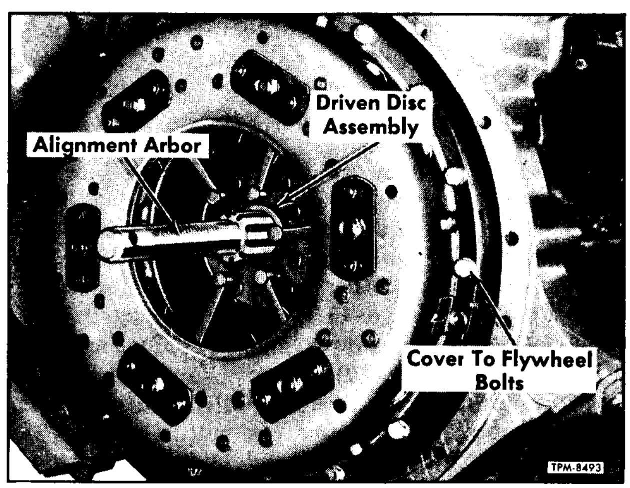


Figure 10—Clutch Cover Assembly Installed (Disc Aligning Tool Shown)

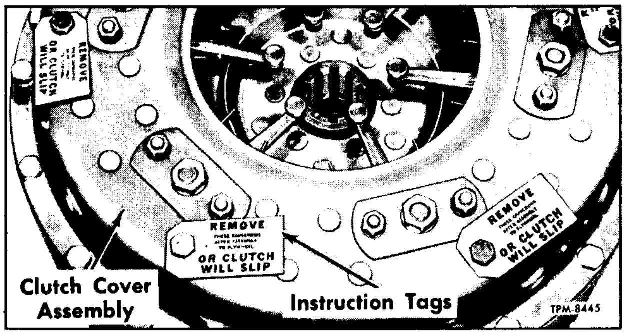


Figure 11—Clutch Cover Bolt Instruction Tags

(cap screws) with tags (fig. 11). Removal of bolts is necessary to allow pressure springs to operate.

NOTE: Bolts used at tag locations (fig. 11) must be removed when installing original or rebuilt clutch cover assembly.

8. After performing the foregoing procedures, use straightedge and scale (fig. 12) to check position of release lever buttons (23). With unworn parts, the surface of release lever buttons must be 1-3/8 inches below cover surface. All levers must be in same plane within 0.030 inch. Position of levers can be changed by turning yoke adjusting nuts as required. Be sure to stake nut to yoke after making adjustment.

NOTE: The yoke adjusting nuts are locked in place at time of manufacture and normally should not be disturbed unless clutch is disassembled.

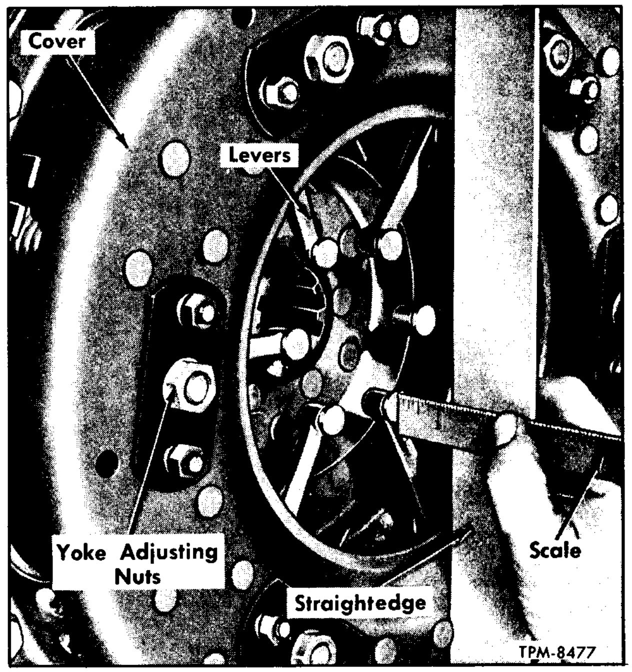


Figure 12—Checking Release Lever Button Position With Scale and Straight Edge

9. Install transmission assembly as instructed in TRANSMISSION (SEC. 17) in this manual.

10. Adjust clutch controls, referring to "Clutch Linkage Adjustments" covered previously in this section.

CLUTCH OVERHAUL

Whenever necessary to disassemble clutch cover and pressure plate assembly, follow the procedure as given below to completely overhaul the unit. Procedure for removing the clutch from engine is given previously in this section under "Clutch Removal."

DISASSEMBLY

Key numbers in text refer to figure 7 unless otherwise indicated.

1. Remove nuts, washers, and thrust plate (29) used to lock each adjusting nut (28).

2. Remove adjusting nuts (fig. 13) from yokes. Hold-down bolts (3/8-16 x 2) will hold springs in compressed position while removing adjusting nuts.

3. Mark cover (12) and pressure plate (9) so that correct relative position will be known when reassembling; then remove six bolts (1, fig. 13), turning screws alternately and in gradual stages until spring pressure between cover and plate has been relieved. Lift clutch cover (12) off the pressure plate assembly.

4. Remove springs and insulators (10 and 11) from pressure plate bosses.

5. Remove cotter pins from release lever pins and pull out pins. Be careful to note position of washers, springs, and number of rollers (31), so parts can be reassembled correctly.

INSPECTION

Prior to inspection, wash clutch parts (except driven disc facings) in cleaning fluid. Refer to "Specifications" at end of this section for dimensions and clearances.

1. Inspect driven disc assembly for worn, loose or oil-soaked facings; for loose rivets at hub; for distortion. If any of these conditions are evident, new driven disc and facings assembly should be used.

2. To inspect release bearing, first soak in cleaning solvent, tap sharply on wood block to dislodge dirt particles, flush in cleaning solvent and blow dry by directing air at right angle to bearing, revolving slowly by hand. Examine bearing for pits

and scores and, if usable, dip in clean oil. Do not disassemble bearings.

3. Inspect pressure plate, center plate, and flywheel plate for checks and scores on contact surface. For refacing of pressure plate, see "Pressure Plate and Flywheel Clutch Plate Repair" under "Repair" later in this section. Check fit of center plate drive lugs in flywheel slots. Dimensions for parts are given in "Specifications" at end of this section. Check surfaces at pressure plate, center plate, and flywheel plate for warpage using straightedge and feeler as shown in figure 14.

4. Check clearance between driving blocks and slotted lugs in pressure plate. If there is indication of wear or scoring on driving blocks, replace same.

5. Clean and inspect rollers used at release lever pins. Replace if rollers show wear.

6. Inspect release levers at needle bearing bores and at thrust buttons. If bearing bores are worn, new levers must be installed at assembly. Thrust buttons can be replaced.

7. Inspect surface on clutch release yoke which contacts buttons in release bearing support. Discard yoke if worn and use new yoke when installing clutch assembly.

8. Test pressure springs (11, fig. 7) and replace any springs which are not within specifications.

REPAIR

PRESSURE PLATE AND FLYWHEEL CLUTCH PLATE REPAIR

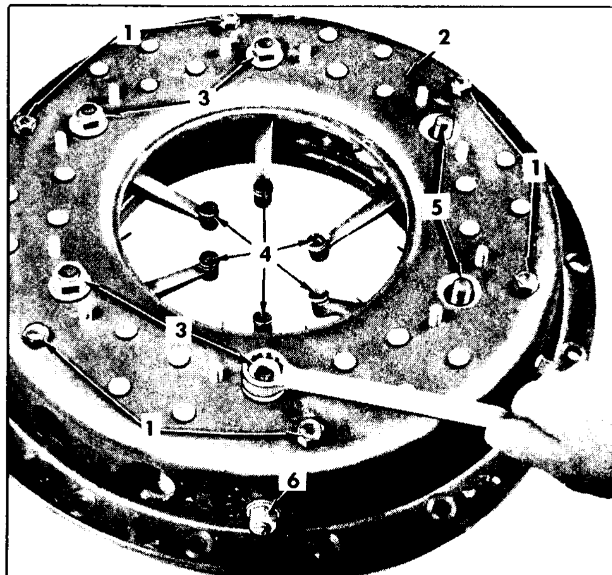
The clutch pressure plate, center plate, or flywheel plate may be refaced by grinding to produce a flat smooth surface. Do not reface parts which are severely heat checked or scored, or if warped in excess of 0.015 inch (fig. 14). If necessary to grind off more than 1/32 inch from pressure plate or flywheel plate to clean up friction surface, new parts should be used at assembly. Before repair of plates is attempted, measure each plate and compare dimensions with new dimensions as listed in "Specifications" at end of this section. Figure 15 shows use of micrometer to check pressure plate thickness. This is necessary to determine if plates have previously been resurfaced.

When resurfacing center plate, no more than 1/64 inch of stock should be removed from each side.

Care must be exercised to maintain friction surfaces parallel with plane of rotation.

To refinish flywheel plate, remove the flywheel assembly from engine and perform machining operation with plate bolted to flywheel. Shim washers 1/32" thick must be used when assembling clutch after resurfacing clutch plates. Therefore, when resurfacing this plate, at least 1/32" of stock should be removed at a time. This will permit the use of the 1/32" shims and thereby maintain torque capacity of clutch. Total thickness of stock removed from plates should not exceed 3/32-inch.

No more than three 1/32-inch shims should be used under each pressure spring when building up clutch cover and pressure plate assembly.



1 3/8-16 x 2 Bolts	4 Release Levers
2 Clutch Cover	5 Release Lever Yoke
3 Yoke Adjusting Nuts	6 Driving Block Nut

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Figure 13—Yoke Adjusting Nut Removal

CLUTCH RELEASE LEVERS

If thrust buttons (23, fig. 7) are worn, press out the worn buttons and install new ones.

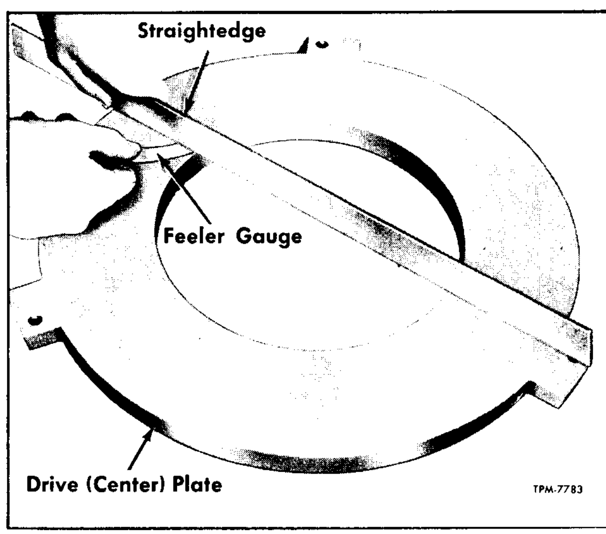
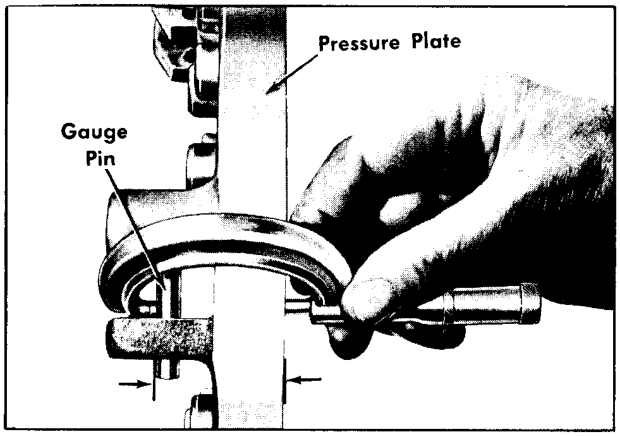


Figure 14—Checking Center Plate For Flatness



Fi ure 15—Measuring Pressure Plate Thickness

CLUTCH RELEASE BEARING AND SUPPORT ASSEMBLY

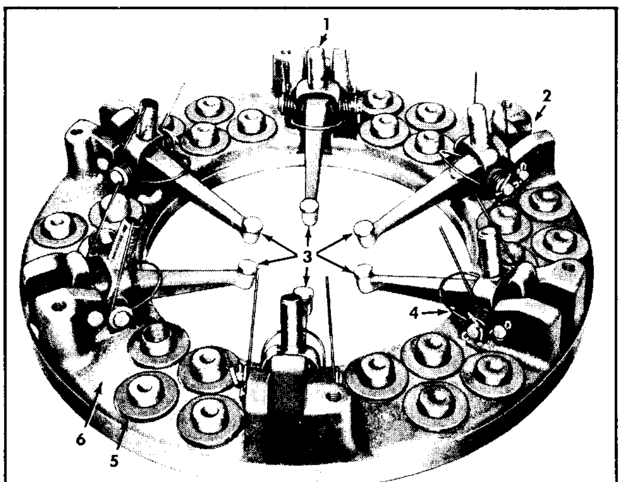
If inspection indicates worn or damaged bearing, use arbor press to press old bearing off support and install new bearing assembly. Bearing inner race must seat solidly against shoulder on support. If thrust buttons (18, fig. 7) are worn, remove worn buttons and install new ones.

CLUTCH ASSEMBLY

Key numbers in text refer to figure 7 unless otherwise indicated.

1. Assemble adjusting yokes (30) and springs (27) on clutch release levers as follows:

a. Make two pilot pins slightly shorter than needle rollers and same diameter as pins (33 and 36). Chamfer ends of pilot pins.



1 Lever Yoke
2 Drive Slot
3 Release Levers
4 Lever Spring
5 Insulating Washer
6 Pressure Plate

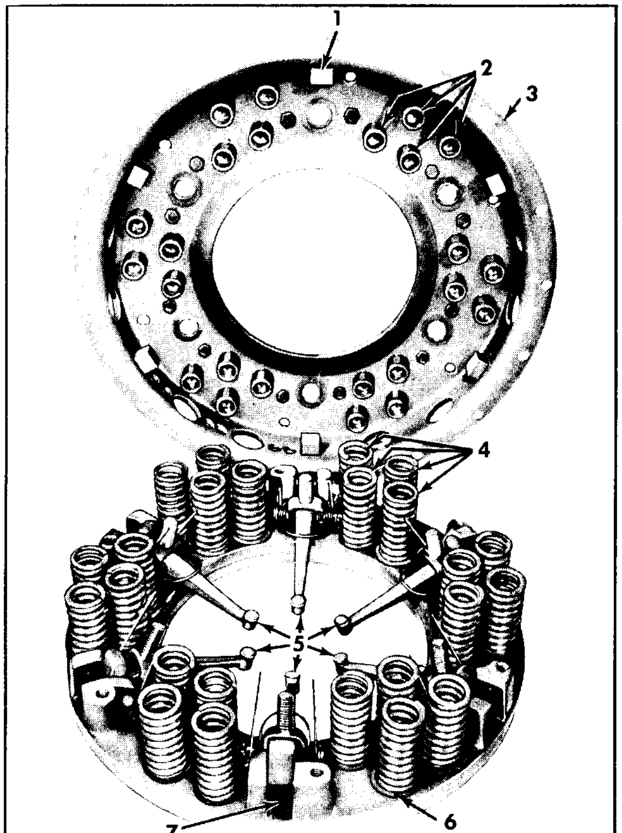
Figure 16—Pressure Plate and Release Levers

b. Lay lever (32) on flat surface and insert a pilot pin in each hole. Arrange full compliment of rollers (31) around each pilot pin. Do not lubricate bearing rollers. Place yoke (30) and spring (27) over lever in position shown in figure 16. Place flat washer on yoke pin (36), then insert pin through spring, yoke and lever, thereby pushing out pilot pin. Assemble flat washer and cotter pin to retain pin (36).

c. Position lever and yoke assembly at pressure plate (9), then install lever pin (33) and retain with cotter pin.

d. Repeat procedure described in steps b. and c. above to assemble each lever to pressure plate. Refer to figure 16 for view of release levers installed on pressure plate.

2. Place pressure plate and levers assembly (fig. 16) face downward on bench. If the pressure plate, center plate, or flywheel plate have been resurfaced, place 1/32-inch shims between insulating washers (28) and spring bosses on pressure plate. Use one shim for each 1/32" of material removed during resurfacing operations. Refer to



1 Drive Block
2 Spring Guides
3 Cover Assembly
4 Pressure Springs
5 Release Levers
6 Spring Insulator
7 Drive Block Slots

Figure 17—Spring Arrangement on Pressure Plate

figure 17 for proper position of springs on pressure plate.

3. When insulating washers (10) and springs (11) are in position, set cover (12) over springs (11), fitting each spring guide on cover into corresponding spring. Cover must assume original position in relation to pressure plate. Refer to alignment marks made at disassembly to determine correct position. Drive blocks (34) must enter slots in pressure plate.

4. See that ends of springs (27) do not catch under cover. Pieces of tubing 1/4 inch by 4-1/2 inches long may be placed on spring ends shown in figure 18, to guide ends of springs past cover.

5. Install six bolts (3/8" - 16 x 2", fig. 18) through holes in cover plate, starting each bolt into tapped hole in pressure plate, then tighten alternately and in gradual stages to compress springs (11) and bring threaded ends of yokes (30) into respective holes in cover plate. Guide yokes through holes as bolts are tightened.

6. Thread adjusting nuts (28) onto yokes (30) so that end of yoke is approximately flush with top of nut. Refer to figure 13.

7. Install adjusting nut thrust plates (29), tightening plate retaining nuts firmly.

8. Clutch assembly now is completely built up and ready to be assembled to flywheel. Bolts (fig. 18) must remain in place until cover to flywheel screws have all been installed, then they must all be removed to allow clutch springs (11) to operate.

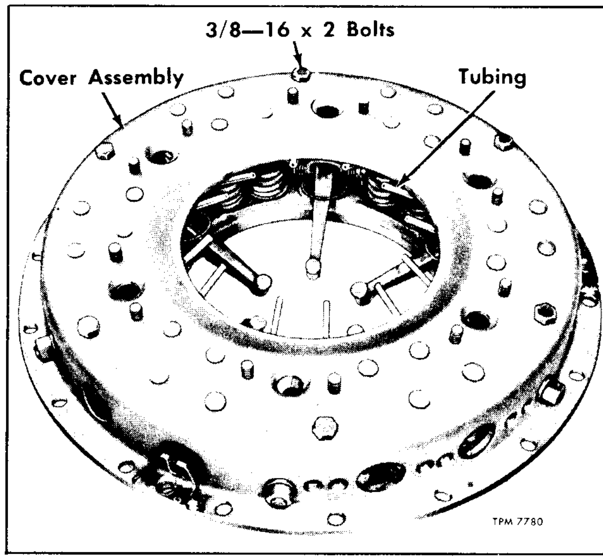


Figure 18—Installing Cover Plate on Pressure Plate

SPECIFICATIONS

Clutch Mfgr.	Long Mfgr. Div.
Type	Direct-Pressure with Two Driven Discs
Size	15-inch
Clutch Driven Discs:	
Number Used	2
Front Driven Disc No. (Stamped)	C-46-K-240
Rear Driven Disc No. (Stamped)	C-46-K-241
Thickness (each disc)	0.4450″
Clutch Pressure Plate:	
Release Lever Pin Hole I.D.	0.3285″-0.3305″
Drive Slot Width	0.7600″-0.7630″
Friction Surface Flat Within	0.005″
New Pressure Plate Thickness (Friction Surface to Pin—Fig. 15)	1.739″-1.750″
Drive (Center) Plate:	
Original Thickness	0.898″-0.892″
Friction Surfaces Flat Within	0.005″
Flywheel Plate:	
Original Thickness	0.745″-0.755″
Friction Surface Flat Within	0.005″
Clutch Pressure Springs:	
Number Used	24
Free Length (Approx.)	2.843″
Lbs. Pressure @ 2″	122.5
Clutch Release Bearing	Ball Type
Clutch Pilot Bearing	Ball Type
Clearance Between:	
Drive Blocks and Pressure Plate	0.008″-0.015″
Drive (Center) Plate Lugs and Flywheel Slots	0.007″-0.012″
Clutch Adjustment:	
Release Levers to Face of Cover (With New Facings)—See Text	1⅜″

CLUTCH RELEASE LINKAGE

Type	Manual with Air Assistance
Air Cylinder:	
Make	Midland Ross
Type	Single Action Piston
Size (Diameter)	2½″
Air Control Valve:	
Make	Bendix-Westinghouse
Type	Pull-in Linkage
Pull Required to Open Inlet Valve	40 lbs.

Keep clutch control linkage properly adjusted and lubricated. Do not over-lubricate clutch release bearing.

Cooling System

DESCRIPTION

Engine is cooled by liquid which is circulated within a sealed system. Cooling system units include: water pump, radiator, surge tank and engine thermostats. A fluid-driven fan mounted on housing at front of engine forces air through radiator core for cooling. As special equipment radiators may be equipped with shutters.

Pressure valve at surge tank is used to maintain pressure within cooling system. Temperature of coolant within engine is controlled by engine thermostats in thermostat housing at front of engine. Cooling system is filled through filler cap at surge tank (fig. 1).

Water for heating coach is supplied from the engine cooling system. Refer to "Heating and Ventilation" in BODY (SEC. 3) of this manual.

An alarm buzzer and tell-tale warning light at instrument panel warns the driver in case engine becomes overheated. In addition some vehicles have a temperature gauge at instrument panel which is operated from electrical sending unit installed on engine.

A water filter is used on some coaches as special equipment, to prevent corrosion and accumulation of sediment in cooling system.

CIRCULATION

Coolant circulation during warm up differs from circulation after engine has reached normal operating temperature as explained in following paragraphs.

ENGINE WARM-UP

The two temperature control thermostats are located in a housing at front of engine. Water pump pumps coolant into cylinder block, by way of engine oil cooler. After circulating through block and cylinder heads coolant enters thermostat housing. When engine is cold (below 170°) the thermostats are closed and prevent coolant from flowing to surge tank and radiator; so the coolant returns to water pump through by-pass openings in housing. During warm-up, coolant also circulates through air compressor cylinder head, and through heater lines in coach body.

AFTER WARM-UP

When coolant reaches temperature at which engine thermostats open, coolant begins to flow through surge tank and radiator. Heat at this time

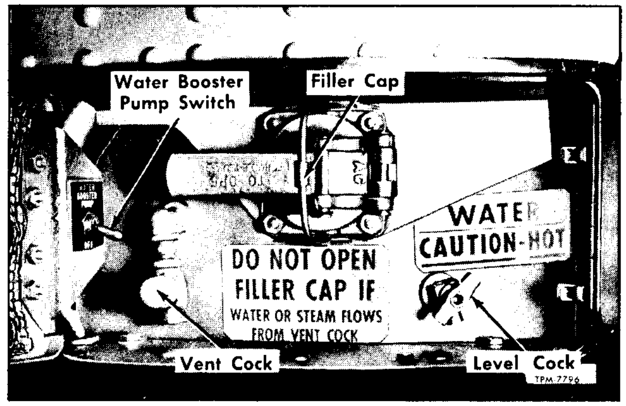
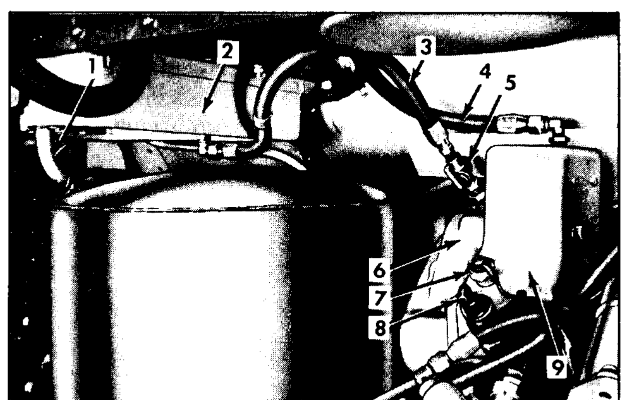


Figure 1—Cooling System Units at Surge Tank

is sufficient to actuate fan control valve and cause the fan to operate. Coolant continues to circulate through air compressor and coach heating system. Refer to applicable DIESEL ENGINE MANUAL for operation of Fluid Fan and Controls.

DRAINING COOLING SYSTEM

Drain cocks are provided at engine, radiator, and in heating system. A shut-off valve in heater line can be closed to permit draining engine without draining heater lines. Press and hold relief valve (vent cock) at surge tank to relieve pressure, then block filler cap open to vent cooling system



1 Pump Return Line
2 Surge Tank
3 Vent Line
4 Deaeration Line
5 Vent Line Shut-off Cock
6 Housing Cover
7 Overheat Sending Unit
8 Temperature Sending Unit
9 Thermostat Housing

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Figure 2—Surge Tank, Thermostat Housing, and Lines

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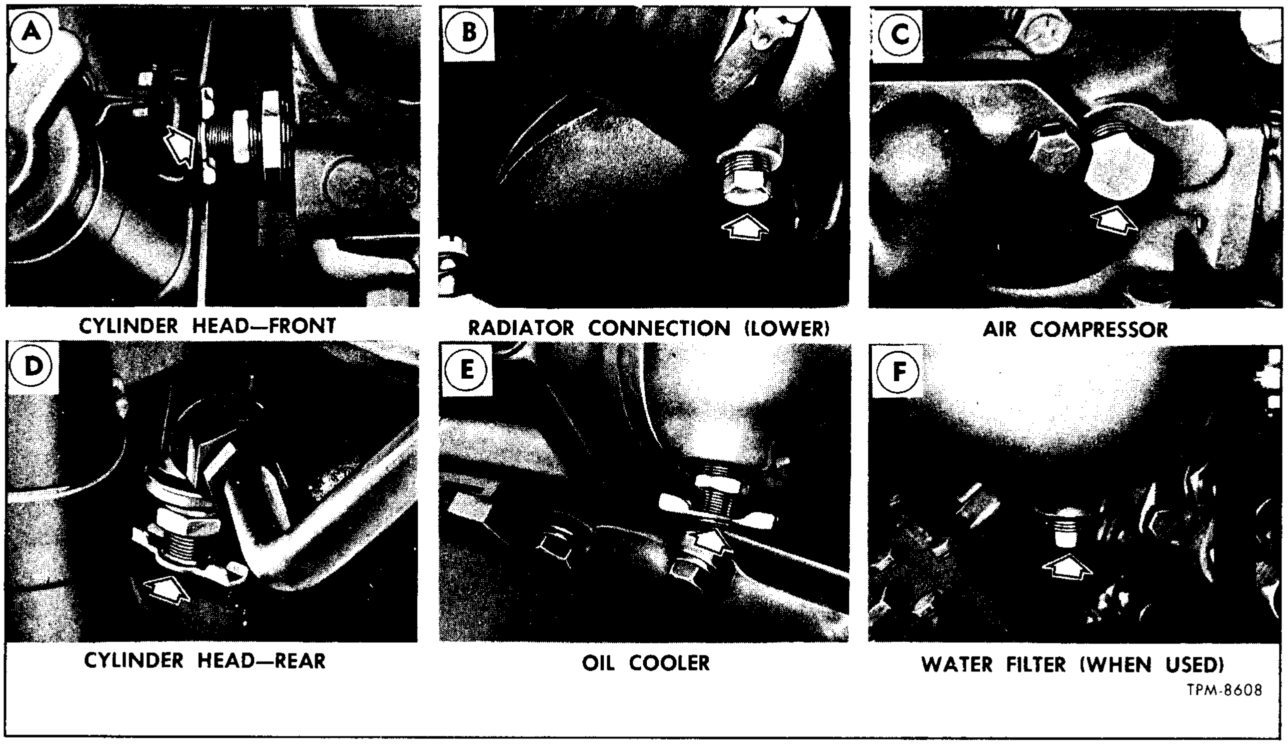


Figure 3—Location of Cooling System Drain Points

while draining. Open drain cocks and remove plugs at points indicated below:

ENGINE COOLING SYSTEM DRAIN POINTS

1. Remove drain plug from radiator outlet connection at bottom of radiator (B, fig. 3).
2. At air compressor, remove plug at side of cylinder block (C, fig. 3).
3. At bulkhead side of engine, open drain cock at oil cooler inlet (E, fig. 3).
4. At rear side of engine, open drain cock at front of cylinder block (A, fig. 3) and drain cock in air compressor water line fitting at cylinder block (D, fig. 3).
5. When used as special equipment, remove plug from bottom of filter housing (F, fig. 3).
6. Refer to "HEATING AND VENTILATION" in BODY (SEC. 3) for instructions covering draining of heater lines.

FILLING COOLING SYSTEM

Only pure, soft water and ethylene glycol type antifreeze should be used in cooling system. Additional information concerning use of antifreeze is given later in this section.

CAUTION: ON COACHES EQUIPPED WITH WATER FILTERS, DO NOT ADD CLEANSING OR RUST PREVENTIVE COMPOUNDS SUCH AS SOLUBLE OIL TO COOLING SYSTEM. FOLLOW THE PROCEDURE GIVEN LATER TO SERVICE THE WATER FILTER.

FILLING EMPTY SYSTEM

1. Close all drain cocks and install drain plugs, referring to draining procedure for location of drain points. If heater line gate valves are closed, they should be opened.
2. Open shut-off cock in vent line at top of thermostat housing at front of engine (fig. 2).
3. Open level cock in surge tank (fig. 1). Through filler cap (fig. 1) slowly fill system to level of level cock (fig. 1).
4. Start engine and run at fast idle until normal operating temperature is reached. Leave engine running at normal idle.
5. At surge tank, hold lever of "WATER BOOSTER PUMP" switch up for a minute or more, which will speed up circulation through entire system.
6. Refer to "HEATING AND VENTILATION" in BODY (SEC. 3) for instructions on bleeding heating units when filling a completely empty system.
7. After all lines have been bled, close vent line shut-off cock at fitting in top of thermostat housing (fig. 2).

REPLENISHING COOLING SYSTEM

1. Press relief valve button (vent cock) on surge tank, and hold in depressed position until all

pressure is relieved from system.

CAUTION: If engine is overheated, wait until boiling stops and engine has cooled before adding cold water. Then with engine running, add water slowly as directed in step 2 following.

2. At surge tank (fig. 1) open level cock and filler cap, then add water to level of level cock (fig. 1). Close level cock when system is full.

3. If water in cooling system was very low, bleed heating system units to make sure all air is expelled. Refer to "HEATING AND VENTILATION" in BODY (SEC. 3).

COOLING SYSTEM INSPECTION AND MAINTENANCE

PERIODIC INSPECTION

At regular intervals, cooling system units should be inspected to determine if service is required. Regular systematic checks will indicate condition of various units and indicate necessity of servicing or replacement of units which can be made before failures occur.

1. At surge tank, check coolant level by pressing vent cock button to relieve pressure, then open level cock (fig. 1). If liquid flows out of level cock, system contains adequate solution. If coolant is low add water as necessary. NOTE: Refer to previous instructions for filling cooling system.

2. Check hose connections and tighten clamps as necessary. Cracked, swollen, or deteriorated hoses must be replaced.

3. Check radiator core and heater cores for leaks and for accumulation of dirt which obstructs air passage. Clean cores with air hose using low pressure. Repair all cooling system leaks when discovered. Refer to applicable DIESEL ENGINE MANUAL for procedure to remove and overhaul water pump.

4. Inspect the radiator mountings and tighten mounting bolts when necessary.

5. If radiator is equipped with shutters, check operation of shutter air cylinder, and service the air filter.

6. Check operation of fluid fan which must not run at full speed when engine is cold, but must operate when engine has reached normal operating temperature.

7. Inspect for clearance between fan blades and radiator. Correct as instructed later in this section under heading "Radiator and Surge Tank."

8. Inspect and service water filter (if used) as directed under "Water Filter" later in this section.

WATER FILTER

Some coaches are equipped with a water filter (fig. 4) as special equipment which has a disposable element and corrosion resistor plates. The required maintenance is described below:

Filter Maintenance

To maintain efficiency of water filter, the filter element should be changed initially after 2500-3000 miles and thereafter every 10,000 miles or after each 300-500 hours of operation.

Key numbers in text refer to figure 5, unless otherwise indicated.

NOTE: Whenever using ethylene-glycol anti-freeze solution, the water filter must be deactivated by closing inlet and outlet shut-off cocks, also drain by removing pipe plug at bottom of housing.

1. Close shut-off cocks (fig. 4).

2. Remove drain plug (5) and allow water to drain from filter.

3. Loosen screws (3) and remove cover and gasket (1 and 2).

4. Remove upper plate (10), filter element (9), lower plate (8), spring and plate (6 and 7).

5. Clean inside of filter housing and clean spring, spring seat, and corrosion-resistor plates.

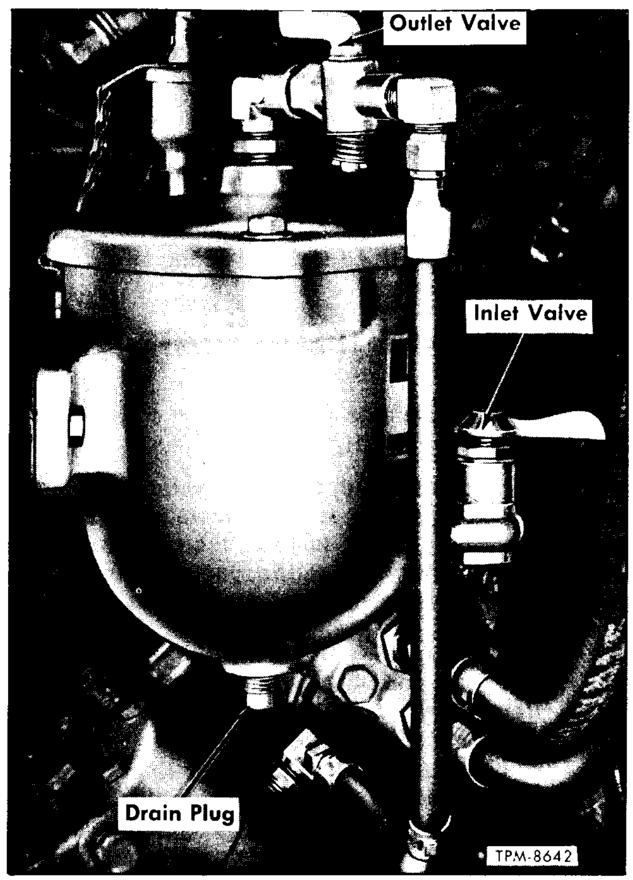
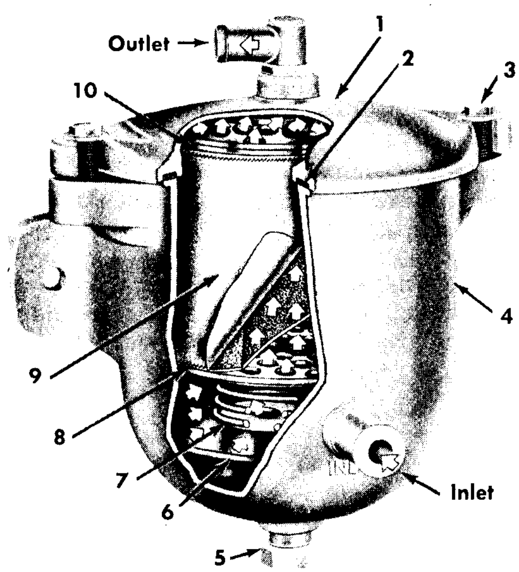


Figure 4—Water Filter Installed

COOLING SYSTEM



1	Cover	6	Sump Plate
2	Gasket	7	Spring
3	Bolt	8	Lower Plate
4	Body	9	Element
5	Drain Plug	10	Upper Plate

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Figure 5—Water Filter Assembly

6. Inspect plates for evidence of pits and erosion. Replace plates if not in good condition.
7. Assemble components in body in order shown in figure 5, using new element. Install cover using new gasket. Open shut-off cocks at side and top of filter housing.

ENGINE THERMOSTATS

Engine thermostats are located in outlet housing at front of engine (fig. 2).

When engine is cold, the thermostats are closed and prevent water from circulating through surge tank and radiator; instead, the coolant passes through by-pass to water pump where it is pumped through oil cooler and returned to cylinder block.

Proceed as follows to replace thermostats:
1. Remove muffler, which is accessible with engine compartment rear door open.
2. Close shut-off valve in heater line and open drain cock in end of cylinder head to drain water level below thermostat housing. Plug at bottom of radiator may be removed to drain out water more rapidly.
3. Remove heat shield. Loosen hose clamps on by-pass hose, also hose clamps on radiator inlet hose.
4. Remove bolts which attach thermostat housing, then remove housing and two thermostats.
5. Place thermostats in position in housing with element toward engine. Install thermostat housing using new gasket. Fit the thermostat housing into by-pass and radiator pipe hoses before installing housing bolts.
6. After installing housing bolts, position hose and tighten clamps. Fill cooling system, start engine and inspect hose connections for leaks. Install heat shield at upper hose near muffler.
7. Install muffler.

TEMPERATURE GAUGE

An electrically operated temperature gauge in instrument panel which registers engine temperature. Sending unit is installed in engine thermostat housing. Circuit does not operate when "MASTER" control switch is in "OFF" and "PARK" positions.

Refer to "Alarm and Signal Wiring Diagram" for electrical wiring circuits when tracing wiring between sending unit and gauge. When used, the sending unit is installed in tapped boss adjacent to engine overheat switch (fig. 2). DO NOT USE THREAD COMPOUND ON SENDING UNIT THREADS when installing.

WATER TEMPERATURE OVERHEAT SWITCH

A tell-tale light at instrument panel and alarm buzzer are used to warn driver of overheated engine. Overheat switch is installed in thermostat housing and is connected to wiring harness. Switch is shown in figure 2. Switch is a sealed unit and is not adjustable.

OPERATION

Engine overheat switch has internal contact points which are normally open at temperature below 210°F. In case engine temperature rises to 210°F. to 214°F., the contact points will close and complete the electrical circuit which causes tell-tale light and buzzer to operate.

OVERHEAT SWITCH REPLACEMENT

1. Disconnect wire from terminal on switch, then use wrench to screw switch body out of thermostat housing.
2. Screw switch into housing and tighten firmly. DO NOT USE COMPOUND ON SWITCH BODY THREADS. Threads are dry-seal type. Use of compound may prevent proper transfer of heat and hinder flow of electric current.
3. Connect wire to terminal.

FLUID DRIVE FAN

A fluid driven fan for cooling radiator is installed at front end of engine.

The fan is driven by torus members located in fan drive torus housing. Oil from engine crankcase is used to fill torus housing to operate fan. Construction, operation, and repair of fluid fan and control valve are covered in applicable GM DIESEL ENGINE MANUAL. The fluid fan control valve is thermostatically actuated by temperature of water in pipe between water pump and radiator. The fan blade assembly is bolted to flange on drive hub.

RADIATOR AND SURGE TANK

Radiator is located at left rear side of coach and is covered by a grille door. Radiator is mounted to body by two rubber insulated hinges (fig. 6) which permits radiator to swing outward, thereby providing accessibility to fan blades, hoses, and so forth at front of engine. A latch and handle (fig. 7) is used which permits radiator assembly to be locked in place or released when it is to be hinged outward. Surge tank, installed above radiator, is equipped with pressure valve assembly. Pressure valve incorporates two valves; one of which relieves excessive pressure and another which admits atmosphere as coolant contracts after engine is stopped. An overflow tube is connected to pressure valve.

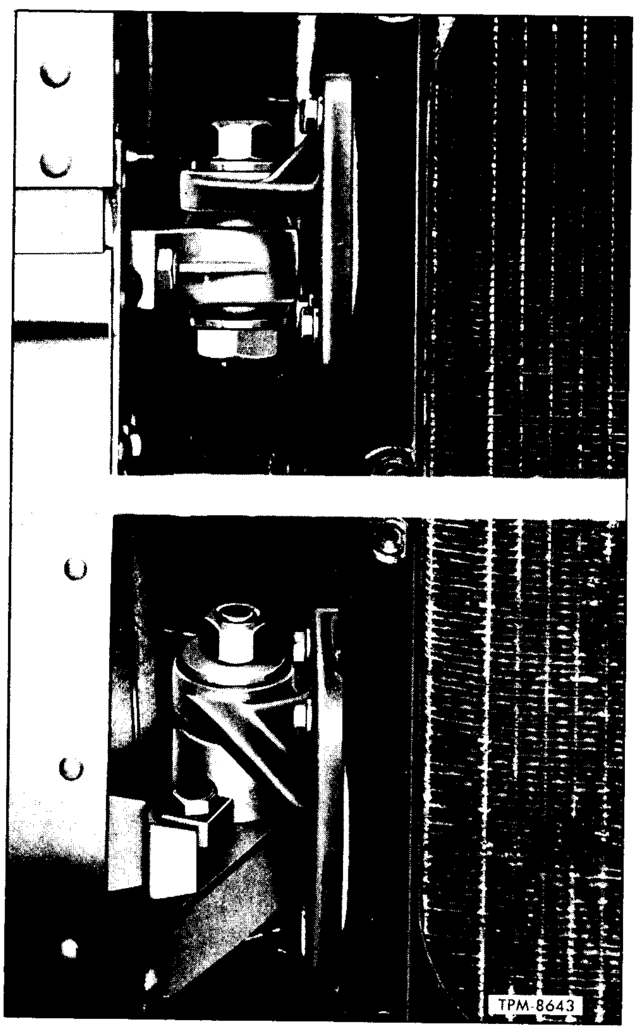


Figure 6—Radiator Hinges

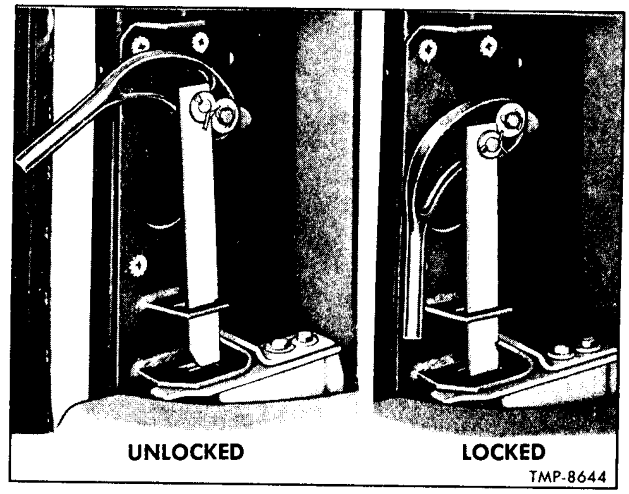


Figure 7—Radiator Latch and Handle

RADIATOR MOUNTING

At periodic intervals inspect radiator hinges for excessive wear or deterioration of rubber insulators (fig. 6).

Check for clearance between fan blades and radiator at points shown in figure 8. Should clear-

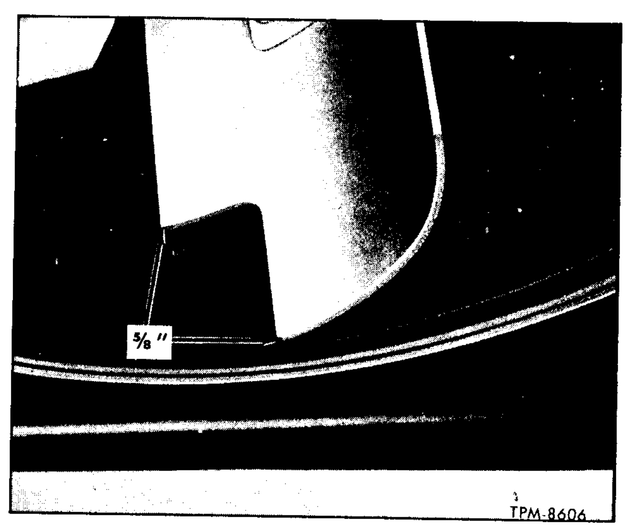


Figure 8—Fan Blade to Radiator Shroud Clearance

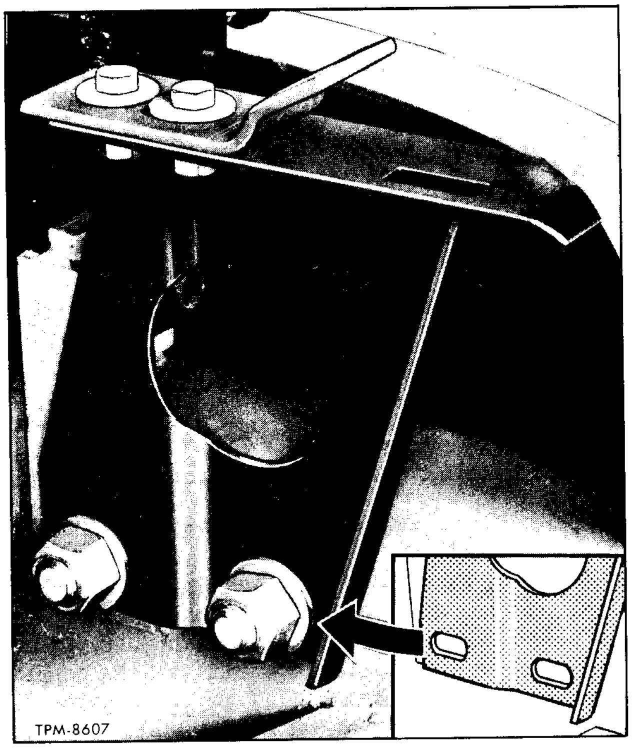


Figure 9—Radiator Latch Adjustable Bracket

ance be less than 5/8" loosen two nuts and shift bracket (fig. 9) as necessary to obtain proper clearance. Tighten nuts securely when proper adjustment has been obtained.

COLD WEATHER OPERATION

In cold regions, antifreeze must be used in cooling system to prevent damage by freezing. Before installing antifreeze solution, cooling system should be inspected and serviced as previously described under "Periodic Inspection."

Tighten cylinder head bolts and, if necessary, replace gasket, to prevent leakage of antifreeze into engine and blowing of exhaust gases into cooling system.

THAWING COOLING SYSTEM

If coolant freezes solid, place coach in a warm building until ice is completely thawed.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD ENGINE BE RUN WHEN COOLING SYSTEM IS FROZEN SOLID.

ANTIFREEZE SOLUTIONS

NOTE: When ethylene-glycol antifreeze is used the water filter must be deactivated as instructed under "Water Filter" heading.

Only ethylene-glycol type antifreeze solution is recommended for use in these vehicle. Ethylene glycol solutions have the advantage of a higher boiling point and may be used at higher temperature without loss, resulting in more efficient performance of cooling system. Ethylene-glycol has the further advantage that, in a tight system, only water is required to replace evaporation losses. However, losses through leakage or foaming must be replaced by additional new solution. Under ordinary conditions, ethylene-glycol solutions are not injurious to body finish.

Anti-freeze solution should be drained at the end of each season. Whenever the anti-freeze solution is to be used another season it should be stored in a suitable container for use in the fall, but should not be used for more than two seasons.

Testing Antifreeze Solution

Always test solution before adding water or antifreeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature. Other testers are provided with thermometers and tables and indicate freezing points corresponding to readings made at various temperatures. Disregarding temperatures of solution may cause an error as large as 30°F. Read and be guided by instructions furnished by tester manufacturer.

SPECIFICATIONS

COOLING SYSTEM CAPACITIES

Quarts of Coolant Required (Approx.)* 92

*Includes Heating System.

ANTI-FREEZE CHART
(Based On 92 Qt. System)

Lowest Expected Temp. (°F.)	Qts. of Ethylene Glycol Required
+10	23
0	30½
−10	35
−20	39½
−30	43½

THERMOSTAT—WATER CIRCULATION

Number Used 2
Start to Open .... 170°
Fully Open .... 185°

OVERHEAT SWITCH (ALARMSTAT)

Make .... AC
Vendor No. 1513806
Points Set to Close at .... 212°F. ±2°

SURGE TANK PRESSURE VALVE

Valve Opens at (Pressure in Lbs. per Sq. In.) .... 6½ to 7¾

FAN

Drive .... Fluid Coupling—from Crankshaft
Drive Control .... Thermostatically-Operated Valve
Number of Fan Blades 6
Diameter .... 30″
Direction of Rotation .... Counterclockwise

TEMPERATURE GAUGE

Make .... AC
Type .... Electrical
Operating Range .... 120° -280°
Voltage 12V

Instructions For Draining And
Filling Cooling System Should
Be Carefully Followed.

Electrical System

WARNING: This coach is equipped with a NEGATIVE GROUND electrical system

This group, covering complete maintenance and repair information on Electrical Systems, is divided into six sections as shown in index below:

NOTE: Specifications are listed at end of each specific section.

INDEX OF ELECTRICAL UNITS

Certain electrical units, when closely associated with some other system or unit, are covered in other sections of this manual. The index following lists all major electrical units, together with the manual section in which they are covered and page number on which the section begins.

Wiring and Miscellaneous Electrical

ELECTRICAL CIRCUIT DIAGRAMS

The electrical system is divided into several separate systems, each system being classified according to its function or purpose. A separate wiring diagram is provided for each major system. In some cases, a circuit on one diagram ties-in with circuits shown on other diagrams, and cross-references are made to other diagrams. Wiring diagrams are inserted in back of this manual. These diagrams include all standard diagrams, and diagrams covering the most commonly used special equipment such as hand brake alarm and automatic engine shut-off systems. Due to the many

various combinations and types of special equipment used by different operators, it is impractical to include all special equipment wiring diagrams in this manual. Each operator can obtain wiring diagrams covering his particular special equipment upon request from the factory. Following is a list of wiring diagrams included in this manual, with a brief outline of the units shown on each diagram.

Engine Control and Generator Wiring Diagrams

MD 88623 - This diagram shows standard circuits used in the engine control and generator system.

MD 88872 - This diagram shows standard circuits, plus automatic engine shut-off system using time delay relay.

MD 89001 - This diagram shows standard circuits, plus automatic engine shut-off system using "MOTO-GARD" relay.

Alarm and Signal Wiring Diagrams

MD 88616 - This diagram shows standard circuits, used in the alarm and signal system.

MD 88871 - This diagram shows standard circuits, plus circuits used with automatic engine shut-off system.

MD 89302 - This diagram shows circuits used on Greyhound coaches.

Coach Lighting Wiring Diagrams

MD 89119 - This diagram shows lighting circuits used on standard coaches.

B-50269 - This diagram shows lighting circuits used on Greyhound coaches.

MD 89563 - This diagram shows a typical seat light circuit.

MD 88755 - This diagram shows the stop and directional signal lamp circuit.

Transmission Wiring Diagram

MD 88754 - This diagram shows the electrical circuit for transmission.

Speedometer Wiring Diagram

MD 88753 - This diagram shows circuit for electrical speedometer.

Heating and Air Conditioning Wiring Diagrams

MD 88620 - This diagram shows electrical circuits for standard GM air conditioning and heating system.

MD 89320 - This diagram shows electrical circuits for Greyhound coaches.

MD 89425 - This diagram shows electrical circuits for standard heating and air conditioning, plus circuit for remote control rheostat.

Lavatory Wiring Diagram

MD 89108 - This diagram shows electrical circuits for coaches equipped with lavatory.

Radio and Public Address System Wiring Diagram

MD 89110 - This diagram shows typical electrical circuits for coaches equipped with Radio and Public Address system.

Hand Brake Alarm Wiring Diagram

MD 89222 - This diagram shows electrical circuits for coaches equipped with hand brake alarm system.

WIRE SIZES AND COLORS

Each wire in the electrical system is of a specific size as designated on the Wiring Diagrams. When replacing wires, the correct size as indicated must be used. Never replace a wire with one of a smaller size.

The insulation on each wire is distinctly colored and patterned to assist in tracing and testing circuits, and to assist in making connections.

Abbreviations and symbols are used in wire insulation color and pattern designations on Wiring Diagrams and in the tabulations which follow. Abbreviations and symbols are as follows:

*Blk. . . .	Black	Nat. . . .	Natural
Brn. . . .	Brown	Or. . . .	Orange
Ch. . . .	Check	Tr. . . .	Tracer
Cr. . . .	Cross	Yell. . . .	Yellow
Grn. . . .	Green	// . . .	Parallel

*All wires leading from electrical compartment junction box into engine compartment are covered with black heat-resistant insulation. To assist in making proper connections, a tag near end of each wire bears the number or abbreviation of the terminal to which it connects.

TESTING CIRCUITS

A careful study of the wiring diagrams should be made to determine the source and flow of current through each electrical circuit. When a circuit is thoroughly understood, a point to point check can be made with the aid of the applicable wiring diagram, to determine location of trouble. Any circuit can be tested for continuity or short circuits with a 2-candle power test light or voltmeter.

All electrical connections must be kept clean and tight. Loose or corroded connections will cause discharged battery, difficult starting, dim lights, and improper functioning of other electrical circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol plugs are securely tightened. Refer to other sections previously listed under "Index of Electrical Units" for information on major electrical units and systems.

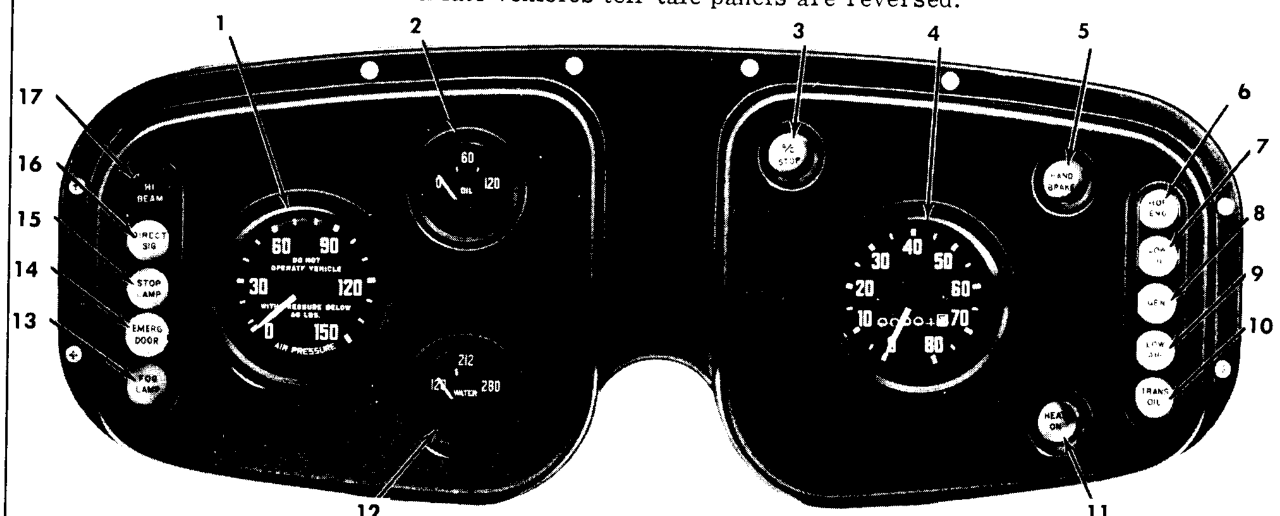
GAUGE AND TELL-TALE PANEL

Gauge and tell-tale panel (fig. 1), mounted directly in front of driver, contains the necessary gauges and tell-tale lights to visually determine condition of systems within coach. Instrument cluster is of unity construction and contains five gauges and thirteen tell-tale lights. The gauges installed on instrument cluster are the Air Pressure Gauge, Engine Temperature Gauge, Oil Pressure Gauge, Generator Charge Indicator, and Speedometer. The tell-tale lights are the Transmission Oil, Low Air, Generator, Low Oil, Hot Engine, Heat On, Hand Brake, Air Conditioning Stop, Fog Lamp, Emergency Door, Stop Lamp, Directional Signal and Hi-Beam. The emergency door tell-tale light is used as special equipment.

Snap-in type instrument light sockets are a part of the wiring harness assembly. Light bulbs are accessible by pulling socket out of holder on back of panel.

Operation of tell-tale lights is explained later under "Tell-tale Alarm System."

NOTE: On late vehicles tell-tale panels are reversed.



1 AIR PRESSURE Gauge
2 OIL Pressure Gauge
3 AIR CONDITIONING STOP Tell-tale
4 Speedometer
5 *HAND BRAKE Tell-tale
6 HOT ENGINE Tell-tale
7 LOW OIL Tell-tale
8 GENERATOR Tell-tale
9 LOW AIR Tell-tale
10 TRANSMISSION OIL Tell-tale
11 HEAT ON Tell-tale
12 WATER TEMPERATURE Gauge
13 FOG LAMP Tell-tale
14 *EMERGENCY DOOR Tell-tale
15 STOP LAMP Tell-tale
16 DIRECT SIGNAL Tell-tale
17 HI BEAM Tell-tale

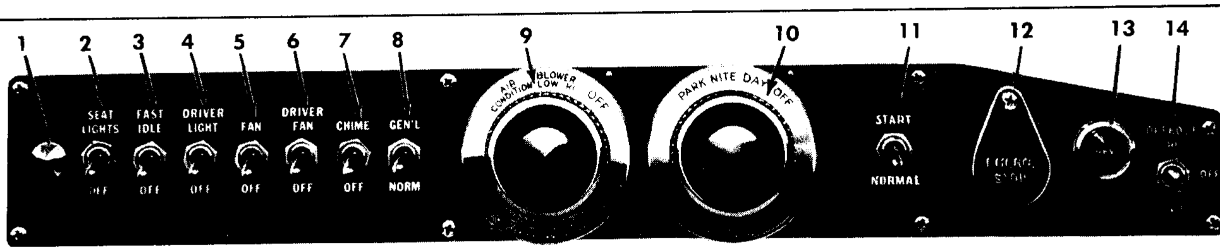
(*) Special Equipment.

TPM-8691

Figure 1—Gauge and Tell-Tale Panel

DRIVER'S CONTROL PANEL

All switches required by the driver for normal operation of the coach are located on the control panel at left of driver. Control panel for coaches with standard and some special equipment are shown in figure 2. All switches and controls on panel are clearly marked for positive identification. Refer to "LIGHTING SYSTEM" section for operation of all light switches. Refer to AIR CONDITIONING (SEC. 26) for operation of air conditioning and ventilation switches. Refer to "HEATING AND VENTILATION" (SEC. 3) for operation of blower and defroster switches. Operation of "MASTER" control switch is described under "Master Switch Operation."



1 Switch Opening Plug
2 *SEAT LIGHT Switch
3 FAST IDLE Switch
4 DRIVER LIGHT Switch
5 FAN Switch
6 DRIVER FAN Switch
7 CHIME Switch
8 GENERAL LIGHT Switch
9 VENTILATION Switch
10 MASTER CONTROL Switch
11 STARTER Switch
12 EMERGENCY STOP Switch
13 TRANSMISSION REVERSE Switch
14 DEFROSTER Switch

(*) Special Equipment.

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Figure 2—Driver's Control Panel

"MASTER" SWITCH OPERATION

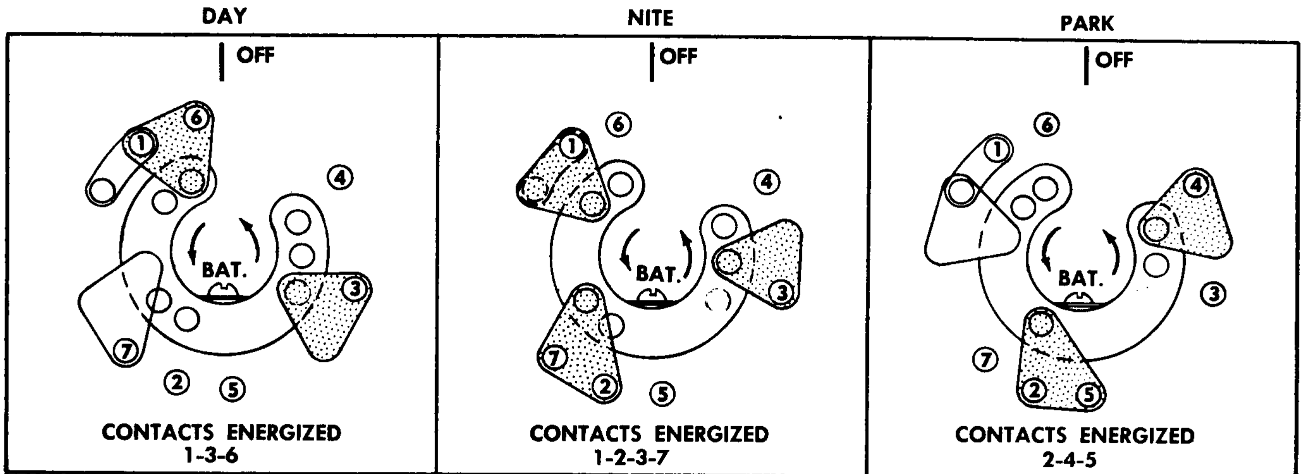
Switch is marked "MASTER" with circuit positions marked "OFF," "DAY," "NITE," and "PARK." Selected circuits become energized when circuit caption on switch is rotated into alignment with position indicator button on control panel. Switch positions, together with the various circuits controlled by each position, are listed below. Refer to figure 3 for schematic diagram of master control switch operation and circuits energized at each position.

DRIVER'S CONTROL PANEL JUNCTIONS

Junction panel, located below the control panel at left of driver, is accessible after removing the junction, circuit breaker, and electrical apparatus panel cover (fig. 4). Junction panel contains 90 terminal posts, numbered consecutively from 1 through 90. Numbers on panel correspond to numbers on Wiring Diagrams and in tabulations which follow. The tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wire which connects to each terminal. Some of the unused terminals, marked "Open" or "Spare" in the tabulation, are available for use with additional special electrical equipment. Driver's control panel junction numbers appear in the symbol ⏥ on Wiring diagrams.

Term. No.	Circuit	Wire Size & Color
1	From Directional Amphenol Plug Pin "B" to Electrical Comp't. Jct. 1	No. 16 Nat.-Red Cr. Tr.
2	From Emergency Stop Switch to Electrical Comp't. Jct. 2	No. 16 Red-2-Grn. // Tr.
3	From Transmission Reverse Switch to Electrical Comp't. Jct. 3	No. 16 Nat.-2-Red // Tr.
4	From Driver's Control Panel Jct. 12 to Condenser Radiator Switch	No. 14 Natural
5	From Oil Pressure Gauge to Electrical Comp't. Jct. 5	No. 16 Nat.-Blk. & Grn. // Tr.
6	Instrument Panel and Marker Lamp Circuits:	
	From Circuit Breaker No. 13	No. 14 Nat.-Blk. Tr.
	To Instrument Panel Lamps	No. 16 Nat.-Blk. Tr.
	*To Side Destination Sign Lamps	No. 16 Brn.-Blk. Cr. Tr.
	To Front Destination Sign Lamps	No. 16 Brn.-Blk. Cr. Tr.
	To Electrical Compartment Jct. 6	No. 14 Nat.-Blk. Tr.
	*To Clearance Lamps	Plain
	To Left-and-Right-Front Corner Marker Lamps	No. 14 Nat.-Blk. Tr.
7	From Speedometer Amphenol Plug Pin "A" to Electrical Comp't. Jct. 7	No. 16 Brn.-Nat. & Blk. Cr. Tr.
8	*From Electrical Comp't. Jct. 8 to Emergency Buzzer	No. 16 Gray
9	From Fast Idle Switch to Hand Brake Switch	No. 16 Nat.-Grn. Tr.
10	From Electrical Comp't. Jct. 10 to Heating Control Relay	No. 14 Yellow-2-Red // Tr.
11	From Emergency Flasher Switch to Electrical Comp't. Jct. 11	No. 14 Grn.-Nat. Cr. Tr.
12	Condenser Radiator Circuit:	
	From Ventilation Switch Contact No. 4	No. 14 Brn.-2-Yellow // Tr.
	To Driver's Control Panel Jct. 4	No. 14 Natural
	*To Accelerator Switch	No. 14 Brn.-2-Yellow // Tr.

*Special Equipment.



"DAY" POSITION (Contacts 1, 3 and 6)

CONTACT NO. 1 CONTROLS:

Circuit Breaker	Amp.	Circuit
No. 3	20	Electric Speedometer
No. 4	20	Engine Stop Solenoid
No. 5	20	Trans. Reverse Gear Solenoid
No. 6	20	Engine Alarm Buzzer
No. 6	20	Engine Low Oil Pressure Tell-tale
No. 6	20	Engine Hot Engine Tell-tale
No. 6	20	Low Air Pressure Tell-tale
No. 6	20	*Emergency Door Tell-tale
No. 6	20	Temperature Gauge
No. 6	20	Oil Pressure Gauge
No. 9	20	Passenger Signal Buzzer
No. 10	20	Driver's Fan
No. 11	20	Defroster Switch
No. 12	20	*Lavatory Controls
No. 15	20	Starter Controls

CONTACT NO. 3 CONTROLS:

Circuit Breaker	Amp.	Circuit
No. 1	20	Generator Tell-tale

CONTACT NO. 6 CONTROLS:
(Contact No. 6 is an open contact) (Spare)

"NITE" POSITION (Contacts 1, 2, 3 and 7)

CONTACT NO. 1 CONTROLS:
(Same as Contact No. 1 of "DAY" position)

CONTACT NO. 2 CONTROLS:

Circuit Breaker	Amp.	Circuit
No. 13	20	Instrument Lamps
No. 13	20	Tail Lamps
No. 13	20	License Plate Lamps
No. 13	20	Corner Marker Lamps
No. 13	20	Identification Lamps
No. 13	20	Nite Lamps
No. 13	20	Lounge Seat Lamp
No. 13	20	Destination Sign Lamps
No. 13	20	*Side Clearance Lamps
No. 13	20	Spot Lamp
No. 13	20	Entrance Door Lamp
No. 13	20	Refrigerant Tank Lamp
No. 19	8	*Aisle Seat Lamps

CONTACT NO. 3 CONTROLS:
(Same as Contact No. 3 of "DAY" position)

CONTACT NO. 7 CONTROLS:

Circuit Breaker	Amp.	Circuit
No. 17	20	Reading Lamps
No. 18	20	Head-Fog Lamp Selector Switch

"PARK" POSITION (Contacts 2, 4 and 5)

CONTACT NO. 2 CONTROLS:
(Same as Contact No. 2 of "NITE" position)

CONTACT NO. 4 CONTROLS:

Circuit Breaker	Amp.	Circuit
No. 7	20	Interior General Lighting

CONTACT NO. 5 CONTROLS:
(Contact No. 5 is an open contact) (Spare)

(*) Special Equipment

NOTE: Additional special equipment lights and other special electrical equipment may also be controlled by the various master switch positions.

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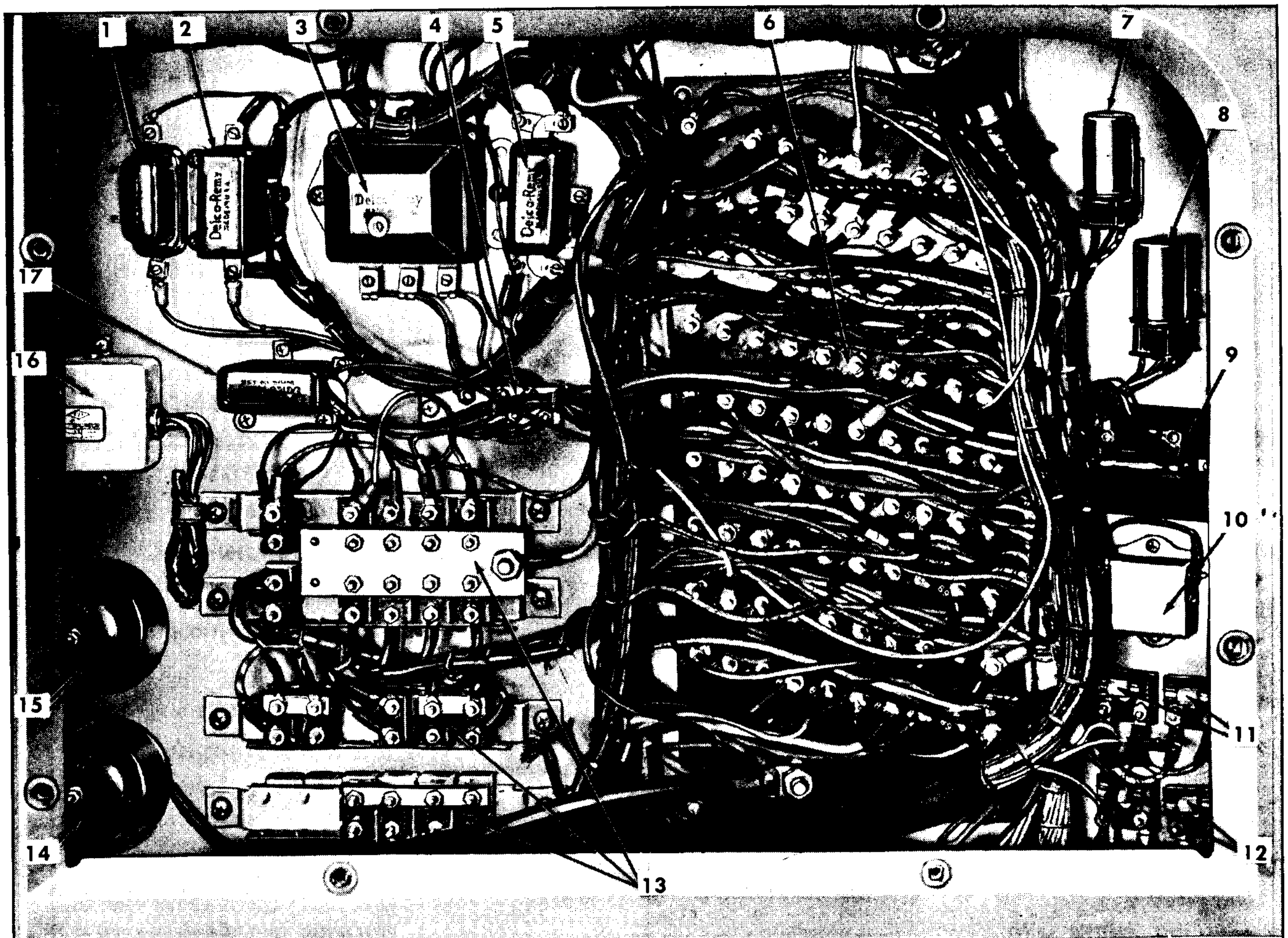
Figure 3—Master Control Switch Positions

DRIVER'S CONTROL PANEL JUNCTIONS (CONT'D)

Term. No.	Circuit	Wire Size & Color
13	From Transmission Low Oil Tell-tale Lamp to Transmission Amphenol Plug Pin "F"	No. 16 Green
14	Heating System Circuit:	
	From Ventilation Switch Contact No. 1	No. 14 Blk.-Brn. Cr. Tr.
	To Ventilation Compartment Jct. 1	No. 14 Blk.-Brn. Cr. Tr.
	To Electrical Compartment Jct. 33	No. 14 Blk.-Nat. Cr. Tr.
15	From Temperature Gauge to Electrical Comp't. Jct. 15	No. 16 Nat.-2-Blk. // Tr.
16	From Interior Lighting Switch to Electrical Comp't. Jct. 16	No. 16 Blk.-Nat. Tr.
17	From Speedometer Amphenol Plug Pin "B" to Electrical Comp't. Jct. 17	No. 16 Nat.-Blk. & Red // Tr.
18	*From Circuit Breaker No. 12 to Electrical Comp't. Jct. 18	No. 16 Red-Blk. Cr. Tr.

*Special Equipment.



1 *Hand Brake Alarm Buzzer
2 Horn Relay
3 Alarm Buzzer and Rectifier
4 Junction Panel (12 Terminals)
5 Fast Idle Relay
6 Junction Panel (90 Terminals)
7 Emergency Flasher Unit
8 Directional Signal Flasher Unit
9 Stop Lamp Resistor
10 *Emergency Door Buzzer
11 Defroster Resistor
12 *Engine Alarm System Resistor
13 Circuit Breaker
14 *Low Air Bell
15 *Fire Alarm Bell
16 *V.C.H. Relay
17 *Two-Speed Governor Relay

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*Special Equipment.

Figure 4—Driver's Control Panel Junction Box

DRIVER'S CONTROL PANEL JUNCTIONS (CONT'D)

Term. No.	Circuit	Wire Size & Color
19	From Starter Switch to Electrical Comp't. Jct. 19	No. 16 Red-Grn. Tr.
20	Spare	Grn.-2-Nat. // Tr.
21	From Directional Signal Amphenol Plug Pin "E" to Electrical Comp't. Jct. 21	No. 16 Nat.-Blk. Cr. Tr.
22	Alarm System Circuits:	
	*From Circuit Breaker No. 4	No. 16 Grn.-Nat. Tr.
	*To Shift Lever Stop Over-Rule Switch	No. 16 Grn.-Nat. Tr.
	*To Electrical Comp't. Jct. 22	No. 16 Grn.-Nat. Tr.
23	From Positive (+) Terminal of Rectifier to Electrical Comp't. Jct. 60	No. 16 Brown
24	From Ventilation Switch Contact No. 3 to Ventilation Comp't. Jct. 2	No. 14 Orange-Red Tr.

*Special Equipment.

DRIVER'S CONTROL PANEL JUNCTIONS (CONT'D)

Term. No.	Circuit	Wire Size & Color
25	Low Oil System Circuits:	
	From Low Oil Tell-tale Lamp	No. 16 Red-Nat. Tr.
	To Alarm Buzzer Terminal No. 4	No. 16 Nat.-Blk. & Grn. Cr. Tr.
	To Electrical Compartment Jct. 25	No. 16 Nat.-Blk. & Grn. Cr. Tr.
26	From Interior Lighting Switch to Electrical Comp't. Jct. 26	No. 16 Blk.-Red Tr.
27	From Speedometer Amphenol Plug Pin "C" to Electrical Comp't. Jct. 27	No. 16 Grn.-2-Red // Tr.
28	From Hand Brake Switch to Hand Brake Tell-tale Lamp	No. 16 Red-Grn. Tr.
29	From Circuit Breaker No. 15 to Electrical Comp't. Jct. 29	No. 16 Grn. Red Tr.
30	Spare	Blk.-Nat. Cr. Tr.
31	From Electrical Comp't. Jct. 31 to Stop Lamp Tell-tale Lamp	No. 16 Red-Blk. Tr.
32	From Emergency Flasher Signal Switch to Stop Lamp Resistor	No. 16 Blk.-Red Cr. Tr.
33	Spare (2-Speed Governor Special Equipment)	Maroon
34	From Electrical Comp't. Jct. 34 to Air Conditioning Stop Tell-tale Lamp	No. 16 Blk.-2-Red // Tr.
35	Hot Engine System Circuits:	
	From Hot Engine Tell-tale Lamp	No. 16 Yellow
	To Alarm Buzzer Terminal No. 5	No. 16 Yellow
	To Electrical Compartment Jct. 35	No. 16 Yellow
36	From Front Step Lamp Switch to Front Step Lamp	No. 16 Yellow-Blue // Tr.
37	From Speedometer Amphenol Plug Pin "D" to Electrical Comp't. Jct. 37	No. 16 Blk.-2-Brn. // Tr.
38	From Hand Brake Switch to Hand Brake Buzzer	No. 16 Blk.-2-Nat. // Tr.
39	From Hand Brake Switch to Fast Idle Relay	No. 16 Blk.-Brn. Tr.
40	Seat Lamp Circuits:	
	*From Seat Lamp Switch	No. 14 Grn.-Brn. Cr. Tr.
	*To Left/Side Seat Lamps	No. 16 Blk.-Grn. Tr.
	*To Electrical Compartment Jct. 40	No. 14 Grn.-Brn. Cr. Tr.
41	From Directional Signal Amphenol Plug Pin "A" to Right-Side Front Directional Lamp	No. 16 Orange-Grn. Tr.
	*Right-Side Directional Lamp	No. 16 Orange-Grn. Tr.
42	Charging Circuit:	
	From Ventilation Switch "BATT" Terminal	No. 12 Brown
	From NO-Charge Tell-tale Lamp	No. 16 Brn.-Blk. Tr.
	To Electrical Compartment Jct. 42	No. 12 Brn.-Blk. Tr.
43	From Circuit Breaker No. 24 to Splice for Baggage Comp't. Lamp Switches	No. 14 Brn.-Red Tr.
44	Defroster Circuit (High):	
	From Defroster Switch (High)	No. 14 Yellow-Blue Tr.
	To Defroster Fans	No. 14 Yellow-Blue Tr.
	To Negative (-) Side of Defroster Circuit Rectifier	No. 16 Yellow-Blue Tr.
45	From Alarm Buzzer Terminal No. 3 to Electrical Comp't. Jct. 45	No. 16 Red-2-Nat. // Tr.
46	Spot and Front Step Lamp Circuit:	
	From Circuit Breaker No. 14	No. 14 Nat.-Blk. Tr.
	To Spot Lamp Switch	Gray
	To Front Step Lamp Switch	No. 16 Nat.-Blk. Tr.
47	From Circuit Breaker No. 3 Electrical Comp't. Jct. 47	No. 14 Green
48	*From Temperature Control Rheostat to Heating Control Relay	No. 16 Blue
49	From Fast Idle Relay to Electrical Comp't. Jct. 49	No. 16 Orange-Red Tr.
50	Spare (Fire Detector Special Equipment)	Blue-Nat. Cr. Tr.
51	From Directional Signal Amphenol Plug Pin "F" to Left-Side Front Directional Lamp	No. 16 Orange-Blk. Tr.
52	Spare	Grn.-2-Blk. // Tr.
53	Spare (2-Speed Clutch Special Equipment)	Blue
54	Defroster System (Low):	
	From Defroster Switch (Low)	No. 14 Yellow-2-Blk. Cr. Tr.
	To Defroster Relay	No. 14 Yellow-2-Blk. Cr. Tr.
	To Negative (-) Side of Defroster Circuit Rectifier	No. 14 Yellow-2-Blk. Cr. Tr.
55	Emergency Door Circuit:	
	From Emergency Door Tell-tale Lamp	No. 16 Blue-Blk. Tr.
	To Alarm Buzzer Terminal No. 1	No. 16 Blue-Blk. Tr.
	To Electrical Compartment Jct. 55	No. 16 Blue-Blk. Tr.
56	From Headlamp Dimmer Switch to Hi-Beam Tell-tale Lamp	No. 16 Nat.-Grn. Cr. Tr.

*Special Equipment.

DRIVER'S CONTROL PANEL JUNCTIONS (CONT'D)

Term. No.	Circuit	Wire Size & Color
57	Starter Circuit:	
	From Starter Switch	No. 16 Blk.-Brn. Ch.
	To Switch Terminal of Voltage Regulator	No. 16 Black
58	Passenger Signal Circuit:	
	From Passenger Signal	No. 16 Orange
	To Passenger Left-Side Signal Switch	No. 16 Orange
	To Passenger Right-Side Signal Switch	No. 16 Orange
59	From Hand Brake Switch to Fast Idle Relay	No. 16 Nat.-Grn. & Red // Tr.
60	Hand Brake Buzzer Circuit:	
	From Shift Lever Stop Over-Rule Switch	No. 16 Brown
	To Hand Brake Buzzer	No. 16 Brown
	To Negative (-) Terminal of Rectifier	No. 16 Brown
	To Electrical Compartment Jct. 60	No. 16 Brown
61	From Directional Signal Amphenol Plug Pin "C" to Emergency Flasher Signal Switch	No. 16 Blk.-Orange Tr.
62	From Circuit Breaker No. 1 to No-Charge Tell-tale Lamp	No. 16 Grn.-Blk. Tr.
63	From Circuit Breaker No. 5 to Transmission Low Oil Tell-tale Lamp	No. 16 Nat.-Red Ch.
64	From Defroster Circuit Rectifier to Ventilation Comp't. Jct.6	No. 16 Nat.-Brn. Tr.
65	Alarm System Circuits:	
	From Circuit Breaker No. 6	No. 14 Nat.-2-Grn. // Tr.
	To Alarm Buzzer Battery Terminal	No. 16 Nat.-2-Grn. // Tr.
65	To Low Air, Low Oil, Hot Engine, Hand Brake Tell-tale Lamps and Temperature, Oil, and Fuel Gauges.	No. 16 Nat.-2-Grn. // Tr.
	*To Emergency Door Tell-tale Lamp	No. 16 Blue-Blk. Tr.
66	From Driver's Lamp Switch to Driver's Lamp	No. 16 Yellow-Blk. Tr.
67	*From Heating Control Relay to Ventilation Comp't. Jct. 10	No. 16 Grn.-Red Ch.
68	From Buzzer Switch to Passenger Signal	No. 16 Orange-Nat. Tr.
69	*Vapor Car Heating System:	
	From Ventilation Compartment Jct. 8	No. 16 Brn.-2-Nat. // Tr.
	To Remote Control Rheostat	No. 16 Brn.-2-Nat. // Tr.
	To Heating Control Relay	No. 16 Brn.-2-Nat. // Tr.
70	*From Windshield Fan Switch to Windshield Fan	No. 16 Red-2-Blue // Tr.
71	From Directional Signal Flasher Terminal "P" to Directional Tell-tale Lamp	No. 16 Nat.-Grn. & Red Cr. Tr.
72	Spare (Tachograph Special Equipment)	Yellow-Blk. Cr. Tr.
73	Open	
74	Heating System Circuits:	
	*From Heating Control Relay	Natural
	To Ventilation Compartment Jct. 5	No. 16 Brn.-Nat. Cr. Tr.
	To Heat-On Tell-tale Lamp	No. 16 Brn.-Nat. Cr. Tr.
75	Low Air System Circuits:	
	From Low Air Tell-tale Lamp	No. 16 Red-Nat. Tr.
	To Alarm Buzzer Terminal No. 2	No. 16 Red-Nat. Tr.
	To Low Air Switch	No. 16 Red-Nat. Tr.
76	From Head-Fog Selector Switch to Fog Lamp Tell-tale Lamp	No. 16 Grn.-2-Nat. // Tr.
77	Spare (Electronic Control Special Equipment)	Nat.-Grn. & Red // Tr.
78	From Horn Relay Terminal "D" to Horn	No. 10 Brn.-Blk. & Red Cr. Tr.
79	*V.C.H. System Circuits:	
	From Temperature Control Rheostat	No. 16 Blk.-Grn. Ch.
	From Ventilation Compartment Jct. 9	No. 16 Blk.-Grn. Ch.
	To Heating Control Relay	Black
80	Ground	Black
81	Directional Signal Circuits:	
	From Directional Signal Flasher Terminal "L"	No. 16 Yellow-Grn. Tr.
	To Emergency Flasher Signal Switch	No. 16 Yellow-Grn. Tr.
	To Directional Signal Amphenol Plug Pin "G"	No. 16 Yellow-Grn. Tr.
82	From Directional Signal Amphenol Plug Pin "D" to Emergency Flasher Switch	No. 14 Blk.-Blue Tr.
83	Open	
84	From Driver's Fan Switch to Driver's Fan	No. 16 Brn.-2-Red // Tr.
85	Spare (Fuel Gauge Special Equipment)	Natural
86	From Circuit Breaker No. 20 to Head-Fog Selector Switch	No. 14 Blk.-2-Grn.-// Tr.
87	Spare (Wheel Sander Special Equipment)	Natural
88	From Horn Button to Horn Relay Terminal "S"	No. 16 Brn.-Red Ch.
89	Open	
90	*Ground for Radio and Public Address System	

DRIVER'S CONTROL PANEL CIRCUIT BREAKERS

Circuit breaker panel, located on the apparatus panel at left of driver's seat, is accessible after removing the panel cover (fig. 4). Panel has space for 24 circuit breakers, however, only 19 are used on coaches with standard electrical equipment. Additional circuit breakers may be used with special equipment.

Circuit breakers are automatic reset type, protecting various circuits as indicated in the tabulation which follows. Any condition which causes an overload on a circuit, such as a short, will cause circuit breaker bimetallic element to open the circuit; when the element cools, circuit breaker will again close the circuit. This off and on cycle will repeat until the switch controlling the defective circuit is turned off, or until the cause of the overload has been located and corrected. In the event a circuit breaker becomes defective (burns out or sticks closed), the defective circuit breaker must be replaced.

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel; to identify circuit breakers, it is necessary to refer to diagram shown in figure 5. Amperage rating of each circuit breaker is also shown in figure 5. Circuit breakers must be installed so the feed or battery wire (or bus bar) connects to the "BAT" or short terminal, and the wire carrying the circuit to the electrical units connects to the "AUX." or long terminal.

The following tabulation lists each circuit breaker number (as identified in figure 5), the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to the circuit breaker terminals.

Circuit Breaker No.	Circuit	Wire Size & Color	Fed From
1	To Driver's Control Panel No. 62	No. 16 Grn.-Blk. Tr.	No. 3 on Master Sw.
	To Starter Switch	No. 16 Grn.-Blk. Tr.	No. 3 on Master Sw.
2	Open		
3	To Driver's Control Panel Jct. No. 47 . .	No. 14 Green	No. 1 on Master Sw.
4	To Driver's Control Panel Jct. No. 22 . .	No. 16 Grn.-Nat. Tr.	No. 1 on Master Sw.
5	To Reverse Switch	No. 16 Nat.-2-Red // Tr.	No. 1 on Master Sw.
	To Driver's Control Panel Jct. No. 63 . .	No. 16 Nat.-Red Cr.	No. 1 on Master Sw.
6	To Driver's Control Panel Jct. No. 65 . .	No. 14 Nat.-2-Grn. // Tr.	No. 1 on Master Sw.
7	To Interior Lighting Switch	No. 16 Brn.-Blk.Red Cr.Tr.	No. 4 on Master Sw.
8	Open		
9	To Chime Switch on Driver's Control Panel	No. 16 Orange-Nat. Tr.	No. 1 on Master Sw.
10	To Driver's Fan Switch	No. 16 Brn.-2-Red // Tr.	No. 1 on Master Sw.
	To Windshield Fan Switch	No. 16 Red-2-Blue // Tr.	No. 1 on Master Sw.
11	To Defroster Switch	No. 14 Yell.-2-Blk. // Tr.	No. 1 on Master Sw.
12	To Driver's Control Panel Jct. No. 18 . .	No. 16 Red-Blk. Cr. Tr.	No. 1 on Master Sw.
13	To Driver's Control Panel Jct. No. 6 . .	No. 14 Nat.-Blk. Tr.	No. 2 on Master Sw.
14	To Driver's Control Panel Jct. No. 46 . .	No. 14 Nat.-Blk. Tr.	No. 2 on Master Sw.
15	To Driver's Control Panel Jct. No. 29 . .	No. 16 Grn.-Red Tr.	No. 1 on Master Sw.
	To Starter Switch	No. 16 Red-Grn. Tr.	No. 1 on Master Sw.
16	Open		
17	To Normal Terminal of Interior Lighting Sw.	No. 16 Blk.-Grn. Tr.	No. 7 on Master Sw.
18	Open		
19	To Seat Lamp Switch	No. 14 Grn.-Brn. Cr. Tr.	No. 2 on Master Sw.
20	Headlamp Switch (Jct. No. 86)	No. 14 Natural	Battery
21	To Directional Flasher Unit Terminal "X"	No. 16 Blk.-Yellow Ch.	Battery
22	To Horn Relay Terminal "B"	No. 10 Red-Nat. Cr. Tr.	Battery
	To Driver's Lamp Switch	No. 16 Yellow-Blk. Tr.	No. 2 on Master Sw.
23	To Interior Lighting Switch	No. 16 Brn.-Nat. Tr.	Battery
24	To Driver's Control Panel Jct. No. 43 . .	No. 14 Brn.-Red Tr.	Battery

ELECTRICAL COMPARTMENT

Electrical compartment (fig. 6) is located at right rear corner of coach behind right rear wheelhouse. To open compartment door, insert fingers under door latch handle, located in center of door at lower edge, then pull out and up on handle to unlatch door. Raise door to full open position and insert pin through holes in telescoping brace to hold door open. To close door, remove pin from brace and lower door. DO NOT DROP DOOR TO CLOSED POSITION. To lock door, lift up on door latch, push door closed, then push latch down and in flush with door.

Components installed in electrical compartment are identified in figure 6.

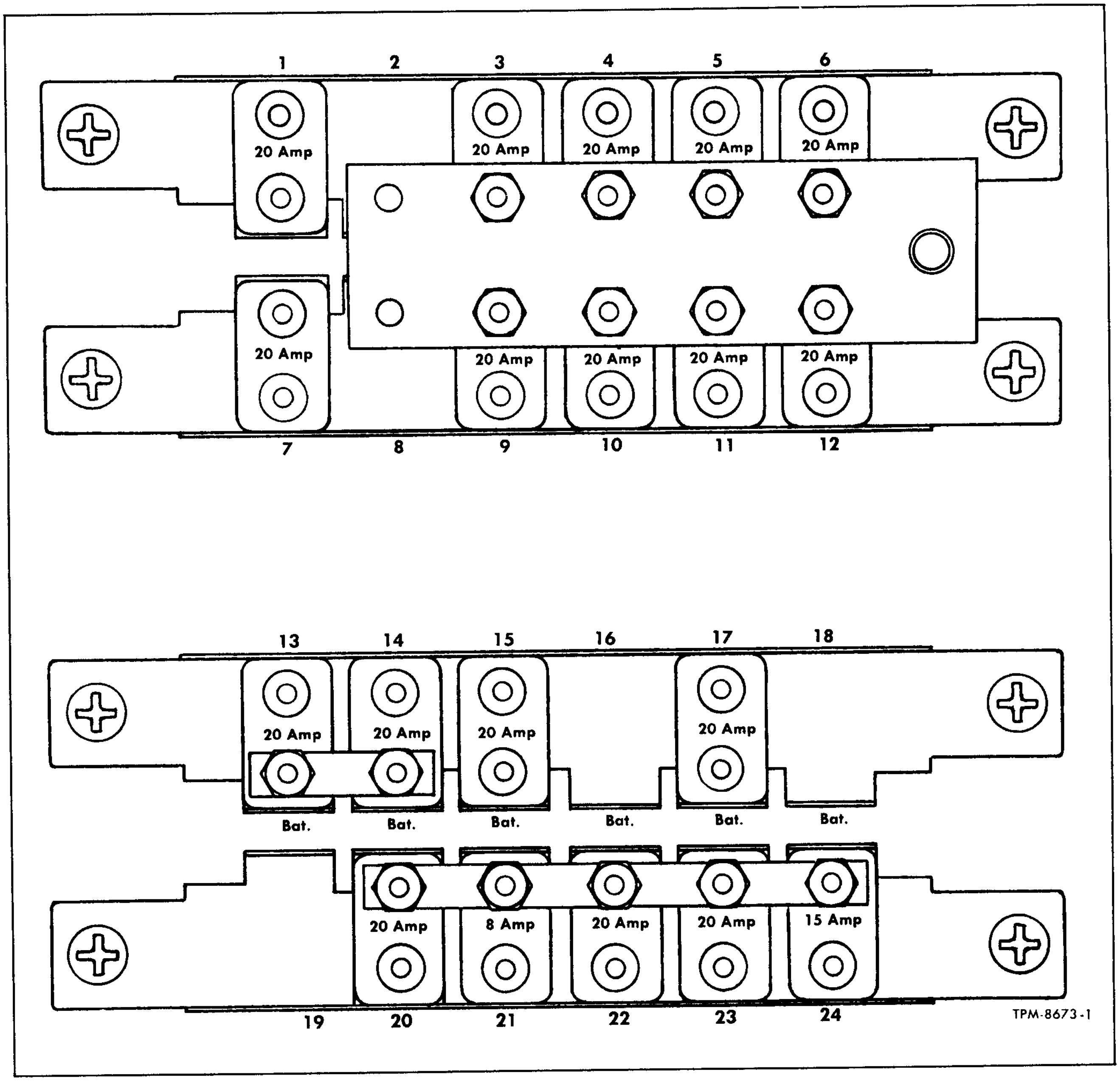

Figure 5—Driver's Control Panel Circuit Breakers

ELECTRICAL COMPARTMENT JUNCTION PANEL

Junction panel in electrical compartment (fig. 6) contains terminal posts numbered from 1 through 64. Numbers on panel correspond to numbers on Wiring Diagrams and in the tabulation which follows. The tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires which connect to the terminal. A similar tabulation printed on a card is attached to a wiring harness in the electrical compartment. Some of the unused terminals, marked "open" or "spare" in the tabulation, may be used for special electrical equipment. Terminal post numbers on junction panel appear on Wiring Diagram in the symbol □

NOTE: Wires leading from the junction panels into the engine compartment are covered with a special black heat-resistant insulation. A tag on each black wire bears the number of the terminal to which it connects.

1 Battery Junction Block
2 Starter Control and Generator Relay
3 Reading Light Magnetic Switch
4 General Light Magnetic Switch
5 Air Conditioning Relay
6 Reverse Relay
7 Stop Light Relay
8 Circuit Breakers
9 Emergency Stop Relay
10 *Temperature Switch Relay
11 Regulator Rectifier
12 Starter Rectifier
13 *Engine Time Delay Relay
14 Resistor
15 *Lavatory Time Delay Relay
16 *Lavatory Blower Relay
17 *Lavatory Control Relay
18 Junction Panel

* Special equipment.

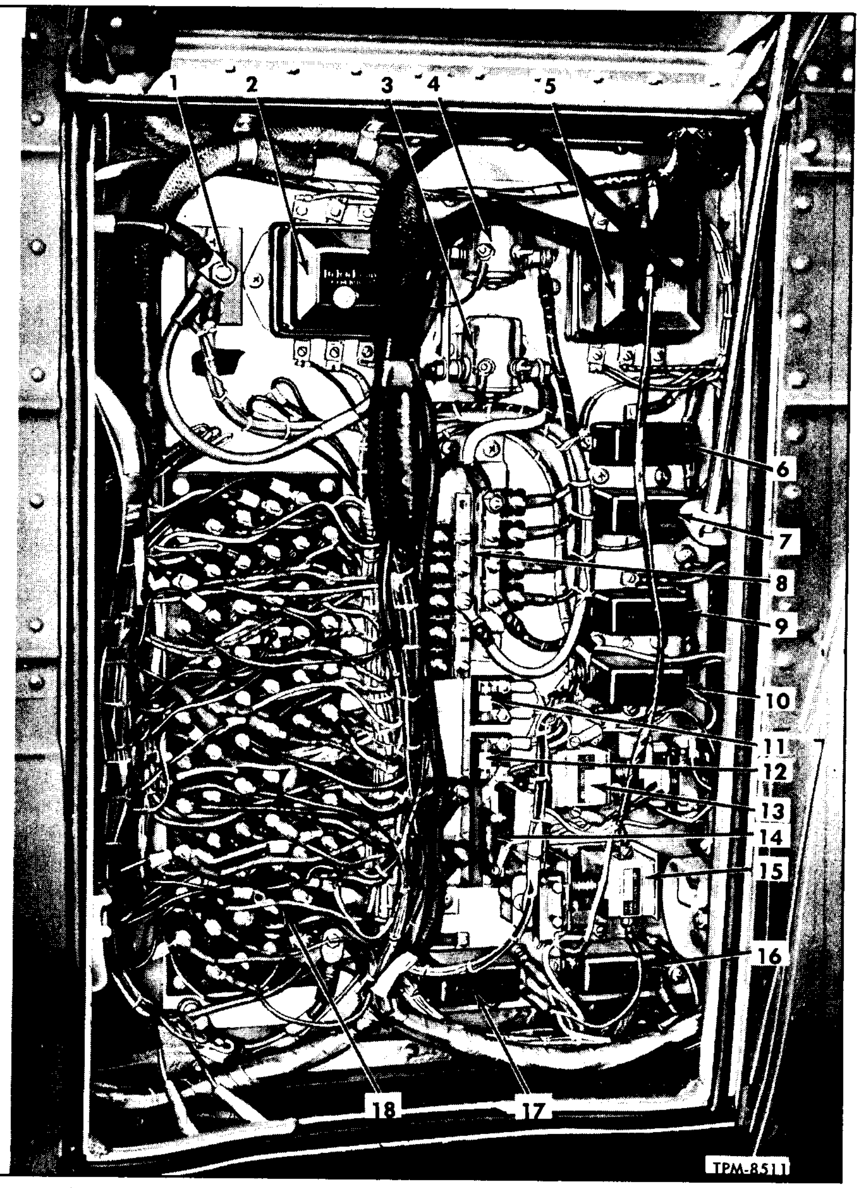

Figure 6—Electrical Compartment Junction Box

ELECTRICAL COMPARTMENT JUNCTIONS

Term. No.	Circuit	Wire Size & Color
1	Right-Side Rear Stop and Directional Signal Lamp Circuit:	
	From Driver's Control Panel Jct. 1	No. 16 Nat.-Red Cr. Tr.
	To Engine Closure Door Amphenol Plug Pin "A"	No. 16 Black
2	From Driver's Control Panel Jct. 2 to Emergency Stop Relay Terminal "VAC"	No. 16 Red-2-Grn. // Tr.
3	From Driver's Control Panel Jct. 3 to Reverse Relay Terminal "VAC"	No. 16 Nat.-2-Red // Tr.
4	Air Conditioning System:	
	From Condenser Radiator Switch	No. 14 Blk.-Grn. Ch.
	To Splice for Hi-Lo and Air Pressure Switch	No. 16 Black
5	Engine Oil Pressure Circuit:	
	From Driver's Control Panel Jct. 5	No. 16 Nat.-Blk. & Grn. // Tr.
	To Engine Oil Pressure Sending Unit	No. 16 Black

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ELECTRICAL COMPARTMENT JUNCTIONS (CONT'D)

Term. No.	Circuit	Wire Size & Color
6	Lighting System Circuits:	
	From Driver's Control Panel Jct. 6	No. 14 Nat.-Blk. Tr.
	To Splice for External Lamps	No. 14 Nat.-Blk. Tr.
	To Engine Closure Door Amphenol Plug Pin "C"	No. 16 Black
	To Left-Side Package Rack Jct. 3	No. 16 Nat.-Blk. Tr.
	To Right-Side Package Rack Jct. 3	No. 16 Nat.-Blk. Tr.
	*To Lavatory Lamp	No. 16 Nat.-Blk. Tr.
7	From Driver's Control Panel Jct. 7 to Transmission Amphenol Plug Pin "A"	No. 16 Brn.-Nat. & Blk. Cr. Tr.
8	*From Emergency Switch in Lavatory to Driver's Control Panel Jct. 8	No. 16 Gray
9	*From Lavatory Control Relay to Ventilator Fan Fuse	No. 14 Yellow
10	*Heating System Water Pump Circuit:	
	From Water Pump Switch	No. 16 Black
	To Driver's Control Panel Jct. 10	No. 14 Yellow-2-Red // Tr.
11	From Driver's Control Panel Jct. 11 to Stop Lamp Relay Terminal "S"	No. 14 Grn.-Nat. Cr. Tr.
12	Generator Field Circuit:	
	From Regulator Switch Terminal	No. 16 Black
	To Regulator Rectifier Positive (+) Terminal	No. 16 Brn.-Red Ch.
13	From Driver's Control Panel Jct. 13 to Transmission Amphenol Plug Pin "F"	No. 16 Green
14	Air Conditioning Clutch Circuit:	
	From Air Conditioning Relay	No. 14 Brn.-Blk. Tr.
	To Air Conditioning Clutch Solenoid	No. 14 Black
15	From Driver's Control Panel Jct. 15 to Engine Amphenol Plug Pin "E"	No. 16 Nat.-2-Blk. // Tr.
16	From Driver's Control Panel Jct. 16 to Reading Lamp Relay	No. 16 Blk.-Nat. Tr.
17	From Driver's Control Panel Jct. 17 to Transmission Amphenol Plug Pin "D"	No. 16 Nat.-Blk. & Red // Tr.
18	From Driver's Control Panel Jct. 18 to Lavatory Control Relay Terminal "VAC"	No. 16 Red-Blk. Cr. Tr.
19	Engine Rear Start Circuit:	
	From Driver's Control Panel Jct. 19	No. 16 Red-Grn. Tr.
	To Rear Start Switch	No. 16 Black
20	Oil Pressure Circuit (Air Conditioning):	
	From Air Conditioning Relay	No. 16 Blk.-Yellow Ch.
	To Air Conditioning Pressure Switch	No. 16 Black
21	Left-Side Stop and Directional Signal Lamp Circuit:	
	From Driver's Control Panel Jct. 21	No. 16 Nat.-Blk. Cr. Tr.
	To Engine Closure Door Amphenol Plug Pin "B"	No. 16 Black
22	From Driver's Control Panel Jct. 22 to Engine Control Switch	No. 16 Black
	*To Shift Lever Stop Over-Rule Switch	No. 16 Grn.-Nat. Tr.
	*From Driver's Control Panel Jct. 22	No. 16 Grn.-Nat. Tr. Grn.-2-Nat. // Tr.
23	Spare	
24	Air Conditioning Controls:	
	From Air Conditioning Relay	No. 16 Nat.-Blk. & Red Cr. Tr.
	To Hi-Lo Pressure Switch	No. 16 Black
25	Engine Low Oil Pressure Circuit:	
	From Driver's Control Panel Jct. 25	No. 16 Nat.-Blk. & Grn. Cr. Tr.
	To Low Oil Pressure Switch	No. 16 Black
26	From Driver's Control Panel Jct. 26 to General Lamp Relay	No. 16 Blk.-Red Tr.
27	From Driver's Control Panel Jct. 27 to Transmission Amphenol Plug Pin "C"	No. 16 Grn.-2-Red // Tr.
28	Open	
29	Engine Rear Start Circuit (Start Position):	
	From Driver's Control Panel Jct. 29	No. 16 Grn.-Red Tr.
	To Rear Start Switch	No. 16 Black
30	Engine Compartment Lamp Circuit:	
	From Circuit Breaker No. 5	No. 14 Orange
	To Engine Compartment Lamp Switch	No. 16 Black
31	From Driver's Control Panel Jct. 31 to Stop Lamp Relay Terminal "D"	No. 16 Red-Blk. Tr.
32	Generator Field Excitation Circuit:	
	From Regulator Field Terminal	No. 10 Black
	From Generator Field Excitation Circuit Resistor	No. 16 Brn.-Nat. Cr. Tr.
	To Engine Amphenol Plug Pin "A"	No. 16 Brn.-Nat. Cr. Tr.

*Special Equipment.

ELECTRICAL COMPARTMENT JUNCTIONS (CONT'D)

Term. No.	Circuit	Wire Size & Color
33	Floor Blower Circuit:	
	From Driver's Control Panel Jct. 14	No. 14 Blk.-Nat. Cr. Tr.
	To Floor Blower Fuse	No. 14 Black
34	Air Conditioning Stop Tell-tale Lamp Circuit:	
	From Hi-Lo Pressure Switch Terminal "Z"	No. 16 Black
	To Driver's Control Panel Jct. 34	No. 16 Blk.-2-Red // Tr.
35	From Driver's Control Jct. 35 to Engine Amphenol Plug	
	Pin "C"	No. 16 Yellow
	*To Temperature Switch Relay Battery Terminal	No. 16 Yellow
36	From Circuit Breaker No. 15 to Left-Side Package Rack Jct.1	No. 10 Blk.- Red Tr.
37	From Driver's Control Panel Jct. 37 to Transmission	
	Amphenol Plug Pin "B"	No. 16 Blk.-2-Brn. // Tr.
	*From Blower Relay to Lavatory Lamp	No. 16 Grn.-Red Ch.
38	Jumper Wire to Occupied Sign Circuit	
39	*Feed Circuit for Water Pump, Door and Emergency Switches	No. 14 Natural
40	*Right-Side Seat Lamp Circuit:	
	From Driver's Control Panel Jct. 40	No. 14 Grn.-Brn. Cr. Tr.
	To Right-Side Seat Lamps	No. 16 Blk.-Grn. Tr.
41	Stop Lamp Relay Power Supply:	
	From Seat Lamp Switch	No. 14 Black
	To Seat Lamp Relay Terminal "B"	No. 14 Grn.-2-Blk. // Tr.
42	Generating System Circuits:	
	From Driver's Control Panel Jct. 42	No. 12 Brn.-Blk. Tr.
	From Regulator Rectifier Negative (-) Terminal	No. 16 Brn.-Blk. Tr.
	To Circuit Breaker No. 10	No. 12 Brn.-Blk. Tr.
	To Water Pump Switch	No. 16 Black
43	Spare (2-Speed Governor Special Equipment)	Maroon
44	Water Pump Circuit:	
	From Ventilation Compartment Jct. 3	No. 16 Blue-2-Nat. // Tr.
	To Water Pump Switch	No. 16 Black
	*From Ventilation Compartment Jct. 6	No. 16 Blue-2-Nat. // Tr.
45	Alarm Buzzer Circuit:	
	*From Engine Stop Time Delay Relay	No. 16 Black
	To Driver's Control Panel Jct. 45	No. 16 Red-2-Nat. // Tr.
46	From Circuit Breaker No.14 to Right-Side Package Rack Jct.2	No. 8 Blk.-Nat. Tr.
47	From Driver's Control Panel Jct. 47 to Transmission	
	Amphenol Plug Pin "E"	No. 14 Green
48	Spare	Brn.-2-Blk. // Tr.
49	Fast Idle Solenoid Circuit:	
	From Driver's Control Panel Jct. 49	No. 16 Orange-Red Tr.
	To Fast Idle Solenoid	No. 16 Black
50	Spare (Fire Detector Special Equipment)	Blue-Nat. Cr. Tr.
51	Stop Lamp Switch Circuit:	
	From Circuit Breaker No. 4	No. 14 Blk.-2-Red // Tr.
	To Stop Lamp Switch	No. 14 Black
52	From Engine Control Switch to Engine Stop Solenoid	No. 16 Black
53	Spare (2-Speed Clutch Special Equipment)	Blue
54	Air Conditioning Controls:	
	From Air Conditioning Relay	No. 14 Brn.-Blk. & Red Cr. Tr.
	To Splice at Oil Pressure Switch	No. 14 Black
55	*From Driver's Control Panel Jct. 55 to Emergency Door Sw.	No. 16 Blue-Blk. Tr.
56	From Circuit Breaker No. 13 to Left-Side Package Rack Jct.2	No. 8 Blk.-Nat. Tr.
57	Open	
58	From Circuit Breaker No.16 to Right-Side Package Rack Jct.1	No. 10 Blk.-Red Tr.
59	Rear Start Switch Power Supply Circuit:	
	From Starter Control and Generator Relay Terminal No. 3	No. 16 Blue-Nat. Tr.
	To Rear Start Switch	No. 16 Black
60	*Engine Stop Over-Rule Circuit:	
	From Driver's Control Panel Jct. 23	No. 16 Brown
	From N.C. Contact of Engine Stop Time Delay Relay . . .	No. 16 Black
	From Driver's Control Panel Jct. 60	No. 16 Brown
	To Engine Stop Solenoid	No. 16 Black
61	Generator Relay Circuit:	
	From Rear Start Switch	No. 14 Black
	To Engine Amphenol Plug Pin "B"	No. 14 Nat.-Grn. & Red Cr. Tr.
62	Starter Cut-Out Circuit:	
	From Rear Start Switch	No. 14 Black
	To Starter Control and Generator Relay Terminal No. 4. .	No. 14 Brn.-Grn. Tr.
63 & 64	Ground	Black

*Special Equipment.

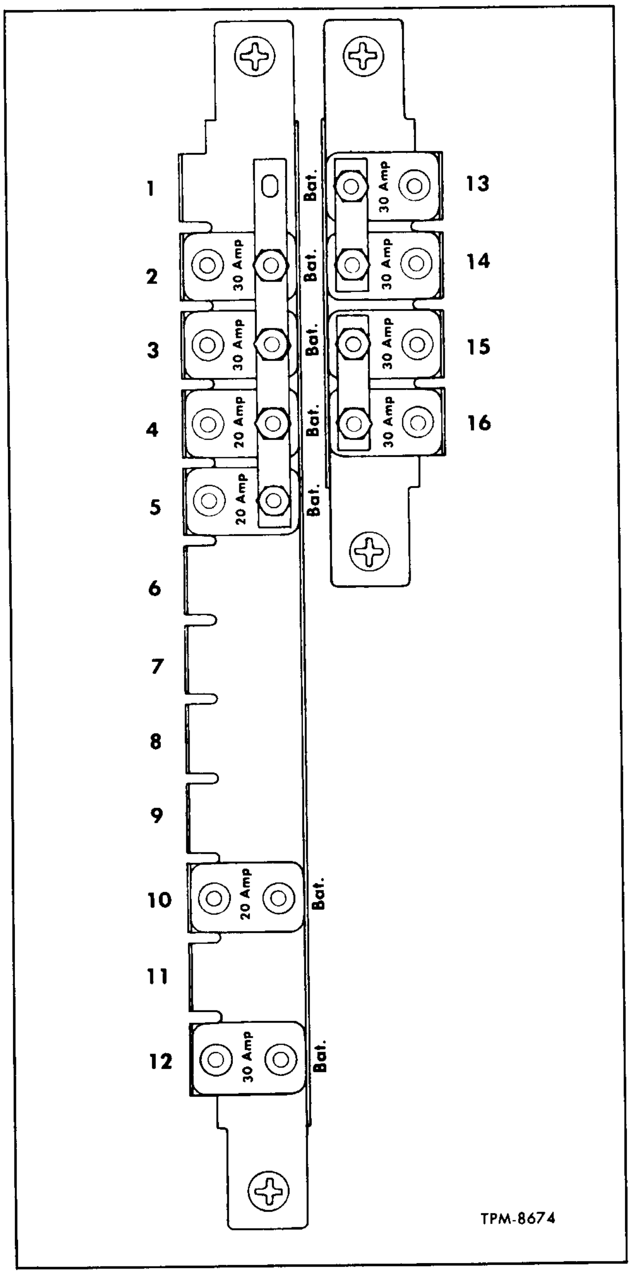


Figure 7—Electrical Compartment Circuit Breakers

ELECTRICAL COMPARTMENT CIRCUIT BREAKERS

Circuit breaker panel (fig. 7) has space for sixteen automatic-reset type circuit breakers. On vehicles with standard electrical equipment, only eleven circuit breakers are used as shown in figure 7. On vehicles equipped with special electrical equipment, other circuit breakers may be used.

Circuit breakers protect various electrical circuits as indicated in the tabulation which follows. Any condition which causes an overload on a circuit will cause the circuit breaker bimetallic element to open the circuit; when element cools, circuit breaker will again close the circuit. This on and off cycle will repeat until the switch controlling the defective circuit is turned off, or until the cause of the overload has been located and corrected. In the event a circuit breaker becomes defective (burns out or sticks closed), the defective circuit breaker must be replaced.

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel. To identify circuit breakers refer to the diagram shown in figure 7.

The following tabulation lists each circuit breaker number (as identified in figure 7), amperage rating, the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to each circuit breaker terminal.

> To help prevent unnecessary trouble to driver while on the road, make sure all terminal junctions are kept clean and tight.
>
> When replacing circuit breakers, make sure the proper amperage rating circuit breaker is used.

ELECTRICAL COMPARTMENT CIRCUIT BREAKERS

Circuit Breaker No.	Circuit	Wire Size & Color	Fed From
1	Open		
2	To Starter Control and Generator Relay Terminal No. 6	No. 10 Green	Battery
3	To "BATT" Terminal of Transmission Reverse Relay	No. 10 Red-Nat. Cr. Tr.	Battery
4	To Electrical Compartment Jct. 51 . . .	No. 14 Blk.-2-Red // Tr.	Battery
5	To Electrical Compartment Jct. 30 . . .	No. 14 Orange	Battery
6	To "BATT" Terminal of Lavatory Control Relay	No. 14 Natural	Battery
	Feed for Water Pump, Door and Emergency Switches for Lavatory	No. 14 Natural	Battery

ELECTRICAL COMPARTMENT CIRCUIT BREAKERS (CONT'D)

Circuit Breaker No.	Circuit	Wire Size & Color	Fed From
7	Open		
8	Open		
9	Open		
10	To Electrical Compartment Jct. 42 . . .	No. 12 Brn.-Blk. Tr.	
	From Starter Control and Generator Relay Terminal No. 5	No. 12 Brn.-Blk. Tr.	
11	Open		
12	To Engine Compartment Amphenol Plug Pin "I"	No. 10 Nat.-Grn. Cr. Tr.	
	To Starter Rectifier	No. 16 Nat.-Grn. Cr. Tr.	
	From Starter Control and Generator Relay Terminal No. 2	No. 10 Nat.-Grn. Cr. Tr.	
13	To Electrical Compartment Jct. 56 . . .	No. 8 Blk.-Nat. Tr.	Reading Lamp Relay
14	To Electrical Compartment Jct. 46 . . .	No. 8 Blk.-Nat. Tr.	Reading Lamp Relay
15	To Electrical Compartment Jct. 36 . . .	No. 10 Blk.-Red Tr.	General Lamp Relay
16	To Electrical Compartment Jct. 58 . . .	No. 10 Blk.-Red Tr.	General Lamp Relay

VENTILATION COMPARTMENT JUNCTION PANEL

Ventilation compartment junction panel contains terminal posts numbered 1 through 12. Numbers on panel correspond to numbers on Wiring Diagrams and in tabulation which follows. The tabulation lists each terminal number the circuit it carries, and the size, color, and pattern of the wires which connect to the terminals. Terminal post numbers on junction panel appear on Wiring Diagrams in the symbol ◇

Term. No.	Circuit	Wire Size & Color
1	Magnetic Blower Relay Circuit:	
	From Driver's Control Panel Jct. 14	No. 14 Blk.-Brn. Cr. Tr.
	To Magnetic Blower Relay Coil	No. 14 Black
2	Blower Motor Circuit:	
	From Driver's Control Panel Jct. 24	No. 14 Orange-Red Tr.
	To Blower Motor	No. 14 Black
3	Water Pump Relay Circuit	
	From Electrical Compartment Jct. 44	No. 16 Blue-2-Nat. // Tr.
	To Water Pump Relay "VAC" Terminal	No. 16 Black
4	Modulating Valve Switch Feed Circuit:	
	From Driver's Control Panel Jct. 42	No. 14 Brn.-Nat. Tr.
	To Modulating Valve Switch	No. 14 Black
5	Modulating Valve Switch "N.C." Circuit"	
	From Driver's Control Panel Jct. 74	No. 16 Brn.-Nat. Cr. Tr.
	To Modulating Valve Switch "N.C." Terminal	No. 16 Black
6	Modulating Valve Switch "N.O." Circuit:	
	From Driver's Control Panel Jct. 64	No. 16 Nat.-Brn. Tr.
	To Modulating Valve Switch "N.O." Terminal	No. 16 Black
7	Spare (Fuel Gauge When Used)	Natural
8	Spare (V.C.H. Heating When Used)	Brn.-2-Nat. // Tr.
9	Spare (V.C.H. Heating When Used)	Blk.-Grn. Ch.
10	Spare (Electronic Control Equipment When Used)	Grn.-Red Ch.
11	Spare (Electronic Control Equipment When Used)	Nat.-Grn. & Red // Tr.
12	Ground	Black

R.S. PACKAGE RACK JUNCTION PANEL

The right-side package rack junction panel contains three terminals, number one connects right-side general lights, number two connects right-side reading lights, and number three connects right-side nite light. Tabulation which follows lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires. Terminal post numbers on junction panel appear on Wiring Diagram in the symbol ⬡

Term. No.	Circuit	Wire Size & Color
1	From Electrical Comp't. Jct. 58 to R.S. General Lights . .	No. 10 Blk.-Red Tr.
2	R.S. Reading Lights Feed Circuit:	
	From Electrical Compartment Jct. 46	No. 8 Blk.-Nat. Tr.
	To R.S. Reading Lights	No. 10 Blk.-Nat. Tr.
3	From Electrical Comp't. Jct. 6 Splice to R.S. Nite Light . .	No. 16 Nat.-Blk. Tr.

L.S. PACKAGE RACK JUNCTION PANEL

The left-side package rack junction panel contains three terminals, number one connects left-side general lights, number two connects left-side reading lights, and number three connects right-side nite light. Tabulation which follows lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires. Terminal post numbers on junction panel appears on Wiring Diagram in the symbol

Term. No.	Circuit	Wire Size & Color
1	From Electrical Comp't. Jct. 36 to L.S. General Lights	No. 10 Blk.-Red Tr.
2	L.S. Reading Lights Feed Circuit:	
	From Electrical Compartment Jct. 56	No. 8 Blk.-Nat. Tr.
	To L.S. Reading Lights	No. 10 Blk.-Nat. Tr.
3	From Electrical Comp't. Jct. 6 Splice to L.S. Nite Light	No. 16 Nat.-Blk. Tr.

AMPHENOL CONNECTORS

Wiring harness connections are made at several points on vehicle through Amphenol multiple plug and receptacle type connectors. Terminals in receptacle and on plug are identified by letters. Locating key in receptacle housing engages a slot in plug to assure proper installation of plug. Letters on plugs and receptacles correspond to letters shown on Wiring Diagrams and in the tabulations which follow. Location of each Amphenol connector, together with the symbols and circuit tabulations, follows.

ENGINE AMPHENOL CONNECTOR

Electrical connections between the terminals, circuit breakers, and electrical units in electrical compartment and the engine wiring harness are made through the top receptacle at rear side of the electrical compartment.

Refer to symbol on Wiring Diagram.

Terminal Letter	Circuit	Wire Size & Color
A	Generator Field Circuit:	
	From Electrical Compartment Jct. 32	No. 14 Brn.-Nat. Cr. Tr.
	To Generator Field Terminal	No. 16 Black
B	Generator Relay Circuit:	
	From Electrical Compartment Jct. 61	No. 14 Nat.-Grn. & Red Cr. Tr.
	To Generator Relay Terminal	No. 14 Black
C	Engine Temperature Circuit:	
	From Engine Overheat Thermostat	No. 16 Black
	To Electrical Compartment Jct. 35	No. 16 Yellow
	*To Temperature Switch Relay "VAC" Terminal	No. 16 Nat.-Grn. Tr.
D	Open	
E	Engine Temperature Sending Unit Circuit:	
	From Engine Temperature Sending Unit	No. 16 Black
	To Electrical Compartment Jct. 15	No. 16 Nat.-2-Blk. // Tr.
F	Open	
G	Open	
H	From Emergency Stop Relay "SOL" Terminal to Emergency Stop Solenoid	No. 10 Brown
I	Starter Solenoid Circuit:	
	From Electrical Compartment Circuit Breaker No. 12	No. 10 Nat.-Grn. Cr. Tr.
	To Starter Solenoid Coil	No. 10 Black

*Special Equipment.

TRANSMISSION AMPHENOL CONNECTOR

Electrical connection from the electrical compartment to the transmission wiring harness are made through the bottom receptical at rear side of the electrical compartment.

Refer to symbol on Wiring Diagram.

Terminal Letter	Circuit	Wire Size & Color
A	From Speedometer Drive Unit "A" to Electrical Comp't. Jct.7	No. 16 Brn.-Nat. & Blk. Cr. Tr.
B	From Speedometer Drive Unit "B" to Electrical Comp't. Jct.37	No. 16 Blk.-2-Brn. // Tr.
C	From Speedometer Drive Unit "C" to Electrical Comp't. Jct.27	No. 16 Grn.-2-Red // Tr.
D	From Speedometer Drive Unit "D" to Electrical Comp't. Jct.17	No. 16 Nat.-Blk. & Red // Tr.
E	From Electrical Comp't. Jct. 47 to Speedometer Drive Unit Fuse	No. 14 Green
F	From Transmission Low Oil Switch to Electrical Comp't. Jct. 13	No. 16 Black
G	Open	
H	From Transmission Reverse Solenoid to Reverse Relay "SOL" Terminal	No. 10 Nat.-Blk. Cr. Tr.
I	Open	

ENGINE CLOSURE DOOR AMPHENOL CONNECTOR

Engine compartment closure door wiring harness, carrying circuits to lights on door, is routed through a rubber grommet at rear side of electrical compartment, and is connected to amphenol connector on engine control panel.

Refer to symbol $\boxed{V}$ on Wiring Diagram.

Terminal Letter	Circuit	Wire Size & Color
A	From Electrical Comp't. Jct. 1 to R.S. Rear Stop and Directional Light	No. 16 Black
B	From Electrical Comp't. Jct. 21 to L.S. Rear Stop and Directional Light	No. 16 Black
C	Power Feed for Rear External Lights	No. 16 Black
D	Ground	Black
E	Open	

BATTERY JUNCTIONS

Battery junctions are located in several places on the vehicle. Battery cables, carrying current to various parts of the vehicle for operation of the electrical units and systems, are connected at these junctions. Connections must be kept clean and tight. If corroded, disconnect cables and thoroughly clean cable ends and junction studs. Reconnect cables to junction studs and tighten stud nuts firmly. Locations of battery cable junctions are as follows:

1. Battery Compartment Junction, located on wall of battery compartment at rear end of upper battery, is accessible after opening battery compartment door.
2. Electrical Compartment Battery Junction, located above junction panel in electrical compartment (fig. 6), is accessible after opening electrical compartment door.
3. Engine Compartment Battery Junction, located approximately in the center of the engine compartment bulkhead on the engine side, is accessible through the engine compartment doors.
4. Driver's Control Panel Battery Junction, located at bottom of junction panel at left of driver (fig. 4), is accessible after the junction panel cover is removed.
5. Air Conditioning Compartment Battery Junction, located on forward wall of inner air conditioning compartment, is accessible through the air conditioning compartment door and inner compartment door.

TELL-TALE ALARM SYSTEM

TELL-TALE LIGHTS

Tell-tale lights are located on gauge and tell-tale panel in front of driver (fig. 1). Tell-tale identification, shown in figure 1, is visible only when the light bulb under the lettering is illuminated. "MASTER" switch on driver's control panel must be in either "DAY" or "NITE" position to energize all tell-tale circuits. Following is a list of all tell-tale lights with a brief description of their purpose and a reference to the Wiring Diagram on which the circuit is shown.

1. "HOT ENG." Tell-tale, interconnected with the alarm buzzer, indicates that the temperature of the engine is too high for safe operation. Engine should be stopped immediately and the overheated

condition corrected. Circuit is shown on "Alarm and Signal Wiring Diagram." Refer to "NOTE" following step 2 below.

2. "LOW OIL." This tell-tale, interconnected with the alarm buzzer, indicates that the engine lubricating oil pressure is below 3 psi. If tell-tale illuminates and buzzer sounds during operation, stop engine immediately and correct the cause of low oil pressure. Electrical circuit is shown on "Alarm and Signal Wiring Diagram." Refer to "NOTE" below:

NOTE: On vehicles equipped with special automatic engine shut-off system, the "HOT ENG." and "LOW OIL" tell-tale circuits are interconnected with a time-delay safety control relay or "Moto-Gard" delay relay which automatically shuts off the engine when either one of these abnormal conditions occur. There is, however, a time lag of 20 seconds (plus or minus 3 seconds) for the time delay relay or 30 seconds (plus or minus 5 seconds) for the "Moto-Gard" delay relay after the tell-tale comes on and buzzer sounds before the relay stops the engine. On some coaches, this condition can be over-ruled by placing the transmission in low gear. Operation of Engine Stop Time-Delay Relay and "Moto-Gard" Relay Systems are described later in this section.

3. "LOW AIR." This tell-tale, interconnected with the alarm buzzer, indicates that air pressure is below 55-60 psi. This pressure will not efficiently operate brakes and air suspension system. If tell-tale illuminates and buzzer sounds during operation, stop the vehicle as soon as possible and correct the cause of low air pressure before proceeding. Refer to "Alarm and Signal Wiring Diagram."

4. "GEN." This tell-tale will light when the "MASTER" switch is placed in "DAY" or "NITE" position and the engine is not running, or when the engine is running and the generator is not charging. If "GEN" tell-tale illuminates during normal operation, the condition should be corrected immediately. Electrical circuit is shown on "Engine Control and Generator Wiring Diagram."

5. "STOP LAMP." This tell-tale illuminates when brakes are applied to indicate normal functioning of stop lights. If tell-tale does not illuminate when brakes are applied, it is an indication that one or both stop-light bulbs are burned out. Refer to "Stop and Directional Light Wiring Diagram."

6. "HI-BEAM." This tell-tale illuminates when headlight high beam is being used. Refer to "Coach Lighting Wiring Diagram."

7. "DIRECT SIG." This tell-tale flashes on and off when directional signals are being used to indicate normal functioning of signals. If tell-tale fails to illuminate when the directional signal switch is placed in either right or left turn position, it is an indication of a burned out directional signal bulb. Electrical circuits are shown on "Stop and Directional Light Wiring Diagram."

9. "EMERG. DOOR." This tell-tale used on some coaches, interconnected with the alarm buzzer, indicates that the emergency exit door is open or partially unlatched. Coach should be stopped and emergency door securely latched for passenger safety. Refer to "Alarm and Signal Wiring Diagram."

10. "A.C. STOP." This tell-tale will illuminate when the refrigerant Hi-Lo pressure switch contacts are open, indicating that the compressor drive clutch is disengaged. Refer to "Air Conditioning Wiring Diagram."

11. "TRANSMISSION LOW OIL." This tell-tale, indicates low oil pressure in the transmission. Electrical circuits and connections are shown on "Transmission Wiring Diagram."

12. "HAND BRAKE." This tell-tale, used on some coaches, will illuminate when the hand brake is applied and "MASTER" switch is in either "DAY" or "NITE" position. Electrical circuits and connections are shown on Hand Brake Alarm Wiring Diagram. Refer to "Alarm and Signal Switches" for hand brake switch operation and adjustment.

13. "FOG LAMP." This tell-tale will illuminate when fog lamps are on and "MASTER" switch is placed in "NITE" position. Electrical circuits and connections are shown on "Coach Lighting Wiring Diagram."

14. "HEAT ON." This tell-tale is illuminated any time the coach heating system is on. Electrical circuits and connections are shown on "Heating and Air Conditioning Wiring Diagram."

ALARM BUZZER AND RECTIFIER ASSEMBLY

Alarm buzzer and rectifier assembly is mounted in driver's control panel junction box at left of driver (item 3, fig. 4). Buzzer and rectifier is interconnected with the "HOT ENG," "LOW OIL," "LOW AIR," and "EMERG. DOOR" tell-tales and their controlling switches, and functions as previously described under "Tell-tale Lights." Refer to "Alarm and Signal Wiring Diagram" for electrical circuits. The rectifier portion of the unit permits current flow in one direction only. Since four different circuits will operate the buzzer, the rectifiers prevent backfeed of current when one abnormal condition exists from illuminating other tell-tales.

Tell-tale and buzzer circuits can be checked for continuity, referring to the "Alarm and Signal Wiring Diagram." The "MASTER" switch must be in "DAY" or "NITE" position to energize the circuits. When checking hot engine tell-tale circuits, engine overheat thermostat terminal must be grounded.

Buzzer points can be cleaned, point opening can be adjusted, and the unit can be adjusted to buzz at a specified amperage. Refer to "Specifications" at end of this group.

ALARM AND SIGNAL SWITCHES

Low oil pressure switch, engine overheat thermostat, and low air pressure switch are covered in other sections of this manual as previously indicated under "Index of Electrical Units."

HAND BRAKE TELL-TALE SWITCH

Operation

Hand brake tell-tale switch, mounted near hand brake cross shaft in tool and inspection compartment, is used to turn on hand brake tell-tale light. Switch is also used to complete hand brake buzzer circuit when hand brakes are applied and transmission is placed in low gear with "MASTER" switch in "DAY" or "NITE" position. Electrical connections for hand brake alarm system are shown on "Hand Brake Alarm Wiring Diagram."

Adjustment (Fig. 8)

1. Loosen clamp bolt securing switch striker on hand brake cross shaft and turn striker away from switch plunger.

2. Place hand brake in fully released position and place transmission shift lever in low gear (1st speed) position. Turn "MASTER" switch to "DAY" position. Hand brake alarm buzzer and tell-tale light should operate.

3. Rotate switch striker on cross shaft against switch plunger, pushing plunger in until buzzer stops and tell-tale light goes out. Tighten switch striker clamp bolt securely.

4. Apply and release hand brakes several times to make sure buzzer and tell-tale operate properly. Turn "MASTER" switch to "OFF" position.

HAND BRAKE FAST IDLE SWITCH

Hand brake fast idle switch is mounted beside hand brake tell-tale switch and is operated by same striker. Switch is used in conjunction with fast idle switch on driver's control panel. With vehicle engine operating and hand brakes applied, fast idle condition can be accomplished by placing fast idle switch on driver's control panel in "FAST IDLE" position. Fast idle will not operate until hand brakes are applied and hand brake fast idle switch is closed. Electrical connections for fast idle system are shown on "Engine Control and Generator Wiring Diagram." Switch is adjusted as previously described under "Hand Brake Tell-tale Switch Adjustment."

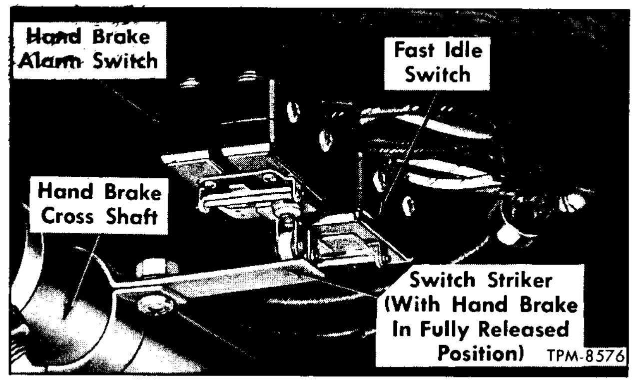


Figure 8—Hand Brake Alarm and Fast Idle Switches Installed

AUTOMATIC ENGINE SHUT-OFF SYSTEM

The air-operated injector shut-off system automatically stops the engine when "MASTER" switch is placed in "OFF" position. Operation and maintenance of this system are covered in "DIESEL ENGINE" (SEC. 8).

On some vehicles, an engine stop time delay relay or "Moto-Gard" relay system is used in conjunction with the air-operated injector shut-off system. The system comprises the time delay relay or "Moto-Gard" relay, two rectifiers, and on some vehicles equipped with a mercury tube type temperature switch, a temperature switch relay and rectifier. All units, except the engine temperature switch are mounted in the electrical compartment junction box (fig. 6). These units are interconnected with the engine overheat and low oil tell-tale system and the engine stop solenoid as shown on "Engine Control and Generator Wiring Diagram MD 88872 and MD 89001" and "Alarm and Signal Diagram MD 89302 and MD 88871." Operation of the system with conventional engine overheat switch (thermostat) (shown on MD 88871) is described below, followed by the differences occasioned when mercury tube type temperature switch and relay are used.

When "MASTER" switch is placed in either "DAY" or "NITE" position, current is supplied through the normally closed contacts of engine stop time delay relay or "Moto-Gard" relay to energize engine stop solenoid. The engine stop time delay or "Moto-Gard" relay heating element circuit is connected through the low oil pressure switch and the engine overheat switch (thermostat).

When low oil pressure or hot engine condition occurs, circuit is completed to energize the engine stop time delay or "Moto-Gard" relay. This circuit opens relay contacts after a time lapse of 20 seconds (plus or minus 3 seconds) for the engine stop time delay relay or 30 seconds (plus or minus

5 seconds) for the "Moto-Gard" relay. When relay contacts open, circuit is interrupted to engine stop solenoid, thereby causing relay to de-energize. When solenoid de-energizes, air pressure is admitted to the injector shut-off air cylinder, and the injector racks are moved to no-fuel position, stopping the engine. On some vehicles, a gearshift lever over-rule circuit is installed. This circuit is explained later in this section.

With Mercury Tube Temperature Switch (MD 89302)

When mercury tube type temperature switch is used, the switch does not draw enough current to actuate the engine stop time delay relay; therefore, the temperature switch relay (10, fig. 6) is added to the system. The temperature switch current draw energizes the relay operating coil, closing the relay contacts; battery current is then fed through the relay contacts to the engine stop time delay relay heating element. The rectifier is used to suppress inductance in the relay coil and prevent damaging the mercury column in the temperature switch.

AUTOMATIC ENGINE SHUT-OFF SYSTEM TEST

Start engine and run for a few minutes to build up air pressure in air system. On vehicles with conventional engine overheat thermostat, ground the thermostat terminal. On vehicles with mercury tube type engine temperature switch, ground the "VAC" terminal on temperature switch relay (10, fig. 6) in electrical compartment. In either case, check time lapse before automatic engine shut-off system acts to stop the engine. Time should be 15 seconds (plus or minus 3 seconds) for engine stop time delay relay or 30 seconds (plus or minus 5 seconds) for "Moto-Gard" relay. If engine does not stop within on minute, check operation of engine stop solenoid and air cylinder before condemning the relay.

NOTE: Low voltage at relay will also cause slow relay action.

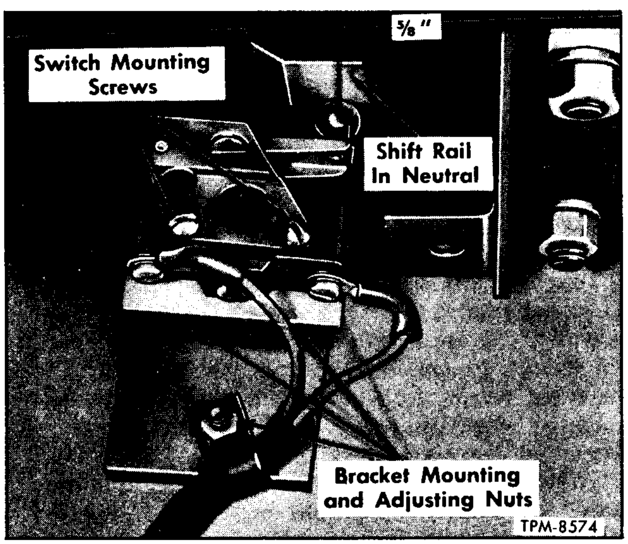


Figure 9—Shift Lever Stop Overrule Switch Adjustment

SHIFT LEVER STOP OVERRULE SYSTEM

The shift lever stop overrule system is used to overrule the automatic engine shut-off system in cases when it is necessary to move vehicle to safety. The system is operative only when transmission is in low gear. The circuit consists of a switch and wiring harness that is connected from driver's control panel junction 22, through switch, then to electrical compartment junction 60 which is connected to engine stop solenoid. Switch also controls hand brake buzzer circuit when used. For adjustment procedures, refer to "Shift Lever Stop Overrule Switch Adjustment" later in this section.

SHIFT LEVER STOP OVERRULE SWITCH ADJUSTMENT (Fig. 9)

1. Place transmission shift lever in neutral position.
2. Loosen three switch bracket mounting screws and manipulate switch and bracket assembly sideway until 5/8-inch clearance exists from centerline of roller to end of shift rail. Tighten switch bracket mounting screws.
3. Loosen two switch to bracket mounting screws, and slide switch upward until switch roller closes switch contacts. Tighten switch to bracket mounting screws.
4. To check operation of switch, place test lamp on terminals at bottom of switch with gearshift lever in neutral position. Test lamp should not light. Place gearshift lever in low gear position and repeat test lamp check. Test lamp should light with this operation. Readjust if necessary.

RELAYS

Relays are used in some instances to automatically open or close a circuit as operating conditions may require; in other cases they are used to provide a direct connection between the battery and an electrically operated device, with only a small amount of current required to energize the relay operating coil flowing through the controlling switch. The latter use eliminates the use of great lengths of heavy wire, thereby providing higher voltage to the electric device. Several of the same type relays are used on each vehicle; however, they are used in different circuits for different purposes.

Location, operation, and adjustment of various

types of relays are described later under individual headings. Before attempting adjustment of relays, make sure points are clean. Clean contact points with a thin, fine-cut file if pitted or burned. Refer to applicable Wiring Diagrams for relay circuits.

The following tabulation lists each relay used, its location on the vehicle, and its part number. After determining part number of relay, refer to instructions under that part number for operation and adjustment.

Relay	Location	Part No.
Defroster Blower	Defroster-Heater Compartment	1116797
Emergency Stop	Electrical Compartment (9, fig. 6)	1116852
Engine Temperature Switch	Electrical Compartment (10, fig. 6)	1116852
Fast Idle	Driver's Control Panel (5, fig. 4)	1116797
General Lights	Electrical Compartment (4, fig. 6)	1114223
Horn	Driver's Control Panel (2, fig. 4)	1116818
Lavatory Blower	Electrical Compartment (16, fig. 6)	1116852
Lavatory Control	Electrical Compartment (17, fig. 6)	1116852
Reading Lights	Electrical Compartment (3, fig. 6)	1114223
Reverse	Electrical Compartment (6, fig. 6)	1116852
Starter Control and Generator	Electrical Compartment (2, fig. 6)	1115810
Stop Light Tell-tale	Electrical Compartment (7, fig. 6)	1850547
Water Pump	Heating and Ventilation Comp't.	1116852

RELAY 1114223 (MAGNETIC SWITCH)

These two relays (magnetic switches) located in electrical compartment (3 and 4, fig. 6) are used in the reading and general lighting system. Both relays are energized by the interior lighting switch. When "MASTER" switch is placed in "PARK" position and interior lighting switch is placed in "NORM" position, both relays are energized, thereby supplying current to operate the reading and general lights. When interior lighting switch is placed in "GEN'L" position, only the general lamp relay is energized. The "MASTER" control switch does not have to be in "PARK" position to operate general lights. Refer to "Coach Lighting Wiring Diagram" for general and reading light circuits.

These relays (magnetic switches) are sealed units and are not adjustable or repairable. If either switch fails to function properly, the defective unit must be replaced.

RELAY 1115810

Starter control and generator relay is mounted in electrical compartment junction box (2, fig. 6). Electrical circuits and connections are shown on "Engine Control and Generator Wiring Diagram." Relay circuits are also illustrated on "Generator System Schematic Wiring Diagram" (fig. 4) in "GENERATOR" section. This is a two-unit relay, with the two units interlocked in such a manner that the starter cannot be engaged when the generator is charging.

The smaller of the two units serves as a starter control relay and the actuating current is supplied through the starter switch; this circuit is routed to ground through the upper contacts of the generator control relay, which are closed only when the generator is not charging. Battery current is supplied to the lower contacts of both relays through terminal number 6. When starter switch is energized and lower points close. Battery current then flows through the lower points and number 2 terminal, through number 12 circuit breaker to the starter solenoid, operating the starter. When the engine starts and starter switch is opened, the operating coil of the starter relay is de-energized and the lower points open, breaking the circuit to the starter solenoid.

The operating circuit of the generator relay (large unit) is fed from the "RELAY" terminal on the generator. When generator is charging, operating coil is energized. With the generator relay operating coil energized, the lower contacts close. Battery current then flows through the lower contacts and number 5 terminal to driver's control panel junction 42. No-charge tell-tale light and heating and air conditioning circuits are connected to junction 42.

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this section for air gap and point opening dimensions and for closing voltage values.

Air Gap (Fig. 10)

Disconnect battery wire from number 6 terminal, then remove relay cover. Check and adjust each unit as follows:

1. Small Unit. Press armature down until lower points just close, then measure air gap between armature and center of core. Adjust, if necessary, by bending the lower contact point support.

2. Large Unit. Press armature down until lower points just close, then measure air gap between armature and center of core. Adjust, if necessary, by loosening two armature hinge bracket attaching screws and moving armature up or down as required. Tighten screws firmly after adjustment.

Point Opening (Fig. 10)

With battery wire still disconnected from number 6 terminal, check and adjust each unit as follows:

1. Small Unit. Measure opening between contact points. Adjust, if necessary, by bending armature stop.

2. Large Unit. Measure opening between lower points with upper points closed. Adjust, if necessary, by bending the upper contact point support.

Closing Voltage (Fig. 10)

Check each unit as follows:

1. Small Unit. Battery wire must be disconnected from number 6 terminal so starter will not operate. Connect an accurate reading voltmeter parallel with the relay operating circuit at terminal numbers 1 and 3. Connect a variable resistance unit in series with the operating circuit at number 3 terminal.

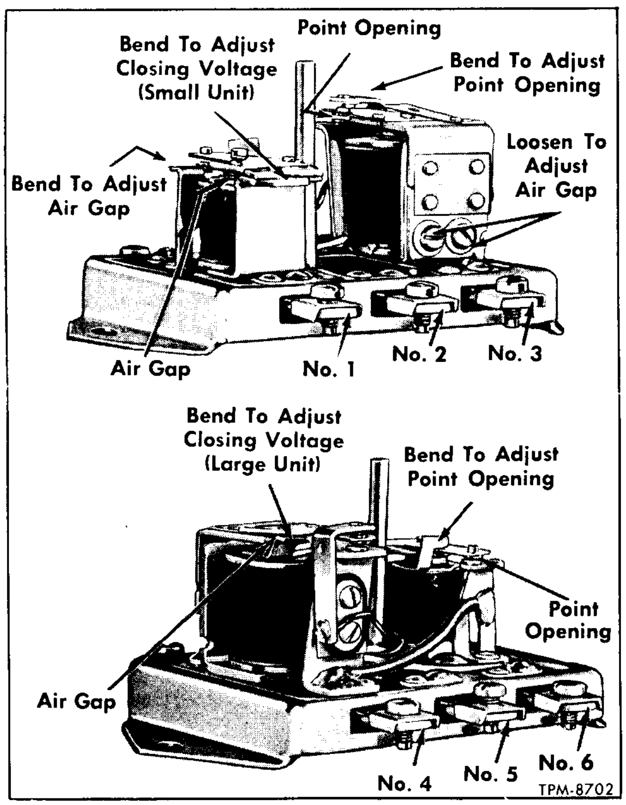


Figure 10—Relay 1115810

While holding engine compartment "ENGINE START" switch in "REAR START" position, slowly decrease resistance until lower points close and note the voltage reading, Adjust, if necessary, by bending the armature hinge bracket to change tension of the spring-type hinge. Increasing spring tension increases the closing voltage; decreasing spring tension lowers the closing voltage.

2. Large Unit. Connect battery wire to number 6 terminal. Connect an accurate reading voltmeter parallel with the relay operating circuit at terminals 1 and 4. Connect a variable resistance unit in series with operating circuit at number 4 terminal. Start engine and run at fast idle. Slowly decrease resistance until points close and note the voltage reading. Adjust, if necessary, by bending the armature spring stop to change tension on spring. Increase spring tension to increase closing voltage; decrease spring tension to lower closing voltage. Remove instruments and make sure wires are all connected and securely tightened after completing adjustment.

RELAY 1116797

Two of these relays are used on vehicles as standard equipment - the defroster blower relay and fast idle relay. Location and function of each relay are descrioed under individual headings. Adjustment procedures apply to both relays. Adjustment points are shown in figure 11.

DEFROSTER BLOWER RELAY

Defroster blower relay is mounted in defroster heater compartment and is accessible after removing compartment panel. Relay is used in defroster blower circuit to provide high and low speeds for defroster blower motors. When "DEFROST" switch (fig. 2) is placed in "HI" position, relay does not operate and blower motors are connected parallel for high speed operation. When switch is placed in "LO" position, relay operating circuit is energized, and the two motors are connected in series for low speed operation. Refer to "Heating and Air Conditioning Wiring Diagram" for circuits and connections. Relay operation is as follows:

"HI" Speed. The "HI" speed circuit is from defroster switch to driver's control panel junction 44. From junction 44, current is supplied to both defroster blower motors. The right-side blower motor is grounded directly through relay ground terminal 6. The left-side blower motor ground circuit is from blower motor to relay terminal "B," from relay terminal "B" through upper contacts of relay, then out terminal "S," which is jumpered to ground through terminal 6.

"LO" Speed. The "LO" speed circuit is from defroster switch to driver's control panel junction

54. Junction 54 is connected to relay terminal "C" and is jumpered to relay terminal "AMM." Current supplied through relay terminal "C" energizes relay, thereby closing lower relay contacts and opening upper contacts. With lower contacts closed, current is routed through contacts, then out terminal "B." Terminal "B" is connected to left-hand blower motor, which is connected to right-hand blower motor. Right-hand blower motor is grounded to relay terminal "G." This connection causes current to be routed through blower motors in series, thereby increasing the resistance in circuit and causes the motor to run at a reduced rate.

FAST IDLE RELAY

The fast idle relay, mounted in driver's control panel junction box (5, fig. 4), is used to complete circuit to energize fast idle solenoid. The purpose of the fast idle system is to put engine in a fast idle condition for purpose of operating heating and air conditioning system, while vehicle is parked. The fast idle switch current is fed from circuit breaker number 23 in driver's control panel junction box, which is hot at all times. When fast idle switch is placed in "FAST IDLE" position, current is supplied up to hand brake switch, which is closed only when hand brakes are applied. This is a safety feature to prevent vehicle from being put in fast idle condition without hand brakes applied. When hand brakes are applied, current is routed to "AMM" terminal of fast idle relay through driver's control panel junction 39. This energizes relay and permits current to be fed through relay contacts and out relay terminal "B." Relay terminal "B" is connected to fast idle solenoid through driver's control panel junction 49 and electrical compartment junction 49.

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing voltage.

Air Gap (Fig. 11)

Remove cover from relay. Press armature down until lower points just close and measure air gap between armature and core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as necessary. If necessary, bend the lower contact support so the air gap will be uniform across top of core.

Point Opening (Fig. 11)

Measure opening between lower points with upper points closed. Adjust point opening, if necessary, by bending the upper contact support.

Closing Voltage (Fig. 11)

Connect an accurate reading voltmeter parallel with the coil winding from "C" terminal to ground. Connect a variable resistance in series with the coil winding at the "C" terminal. Turn on applicable switch to energize the coil winding. Slowly decrease resistance until lower contacts close and note the reading on voltmeter. If not within range listed in "Specifications," adjust by bending the armature spring post to increase or decrease spring tension. Increasing spring tension increases the closing voltage, and decreasing spring tension decreases the closing voltage.

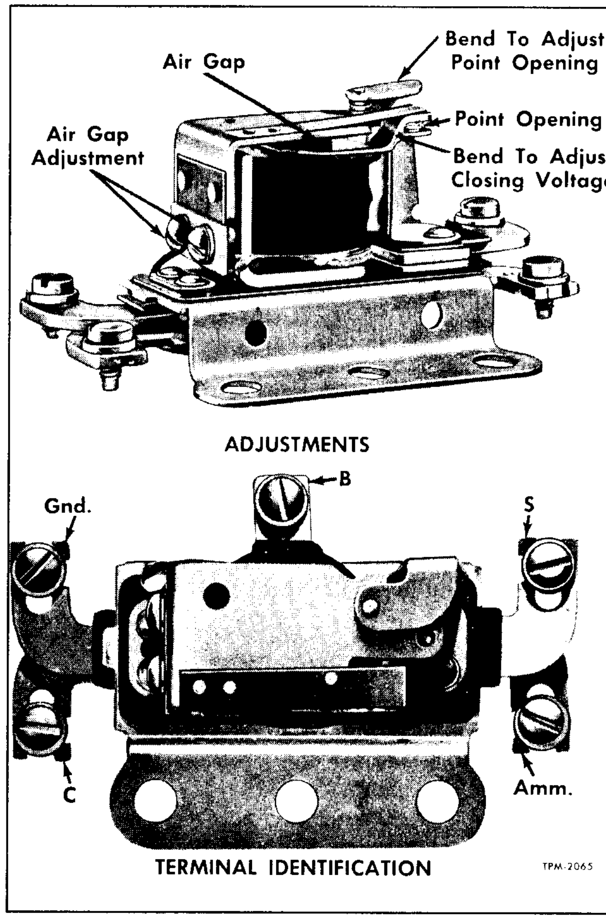


Figure 11—Relay 1116797

RELAY 1116818

This relay, used only in the horn circuit, is mounted in driver's control panel junction box at left of driver (2, fig. 4). Relay circuits and connections are shown on "Alarm and Signal Wiring Diagram." Coil windings of relay are connected in series with the horn button. When horn button is pressed, circuit through relay winding is completed and armature is attracted to core. This completes the circuit from the "B" terminal through the closed points and "D" terminal to the horn.

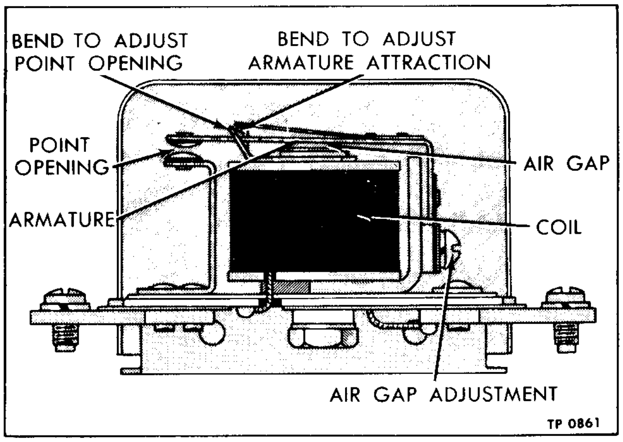


Figure 12—Relay 1116818

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this section for air gap and point dimensions and for closing voltage.

Air Gap (Fig. 12)

Disconnect wire from "B" terminal and remove relay cover. Press armature down until points just touch and measure air gap between armature and core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and the armature.

Point Opening (Fig. 12)

With wire still disconnected from "B" terminal, measure contact point opening with armature up against stop. Adjust opening, if necessary, by bending the armature stop.

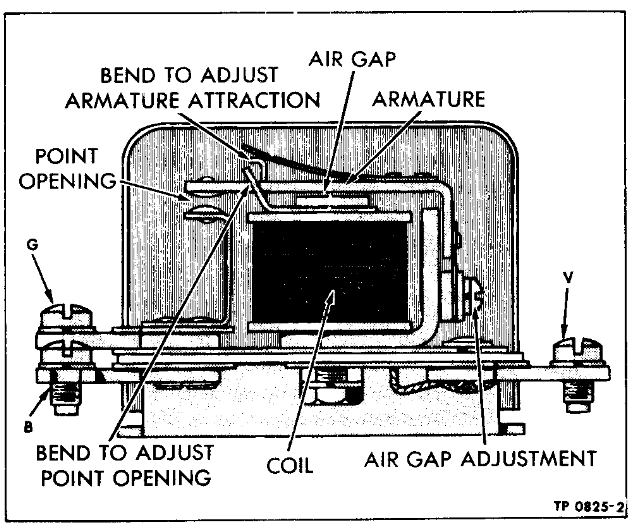


Figure 13—Relay 1116852

Closing Voltage (Fig. 12)

Connect an accurate reading voltmeter parallel with the operating circuit at the "B" and "S" terminals. Connect a variable resistance unit of 10 ohms in series with the operating circuit at the "B" terminal. With horn button pressed, slowly decrease resistance until points close and note the voltmeter reading. Adjust, if necessary, by bending the armature spring post to change tension of armature spring. Increasing spring tension increases the closing voltage, and decreasing spring tension decreases the closing voltage.

RELAY 1116852

Several of these relays are used on each vehicle as indicated in the "Relay" tabulation previously. Location and function of each relay are described under individual headings. Adjustment instructions apply to all units. Relay adjustment points are illustrated in figure 13.

REVERSE RELAY

The reverse relay is mounted in electrical compartment (6, fig. 6). Purpose of relay is to complete circuit from battery to reverse solenoid on transmission. Relay circuits and connections are shown on "Transmission Wiring Diagram." Relay operation is as follows:

When "MASTER" control switch is placed in either "DAY" or "NITE" position, current is supplied to driver's control panel junction circuit breaker number 5, which furnishes current to transmission reverse and low oil circuits. When transmission "REV" switch is pressed, current is supplied to "VAC" terminal of reverse relay through number 3 terminal of driver's control and electrical compartment junctions.This energizes relay coil, thereby closing relay contacts. With relay contacts closed, current is supplied from electrical compartment circuit breaker number 3 to transmission reverse solenoid through relay contacts and transmission amphenol plug pin "H."

EMERGENCY STOP RELAY

The emergency stop relay is mounted in electrical compartment (9, fig. 6). Purpose of relay is to complete circuit from battery to emergency stop solenoid in engine. Relay circuits and connections are shown on "Engine Control and Generator Wiring Diagrams." Relay operation is as follows:

Emergency stop switch is fed hot from control panel battery junction and is operative anytime switch is pressed. When emergency switch is pressed, circuit is completed to energize relay coil, through driver's control and electrical compartment junctions 3. When relay contacts close, emergency stop solenoid is energized by current

fed from engine compartment battery junction through relay contacts and engine amphenol plug pin "H."

LAVATORY CONTROL RELAY

The lavatory control relay used on vehicles equipped with lavatory, is mounted in electrical compartment (17, fig. 6). Relay is used to automatically operate lavatory ventilating fan, when "MASTER" control switch is placed in "DAY" or "NITE" position. Relay circuits and connections are shown on "Lavatory Wiring Diagram." Operation of relay is as follows:

When "MASTER" control switch is placed in "DAY" or "NITE" position, current is supplied to driver's control panel circuit breaker number 12. Circuit breaker number 12 is connected to relay coil windings through driver's control and electrical compartment junctions 18. When relay contacts close, current is supplied from electrical compartment circuit breaker number 6, through relay contacts, relay terminal "SOL," electrical compartment junction 9, 6-amp line fuse to ventilating fan.

LAVATORY BLOWER RELAY

The lavatory blower relay, used on coaches equipped with lavatory, is mounted in electrical compartment (16, fig. 6). Relay is used to operate lavatory ventilating fan when lavatory door is closed and "MASTER" control switch is in "OFF" or "PARK" position. Relay circuits and connections are shown on "Lavatory Wiring Diagram." Operation of relay is as follows:

Electrical compartment circuit breaker number 6, fed hot from battery junction, supplies current to lavatory door switch. When lavatory door is closed, current is supplied to illuminate occupied sign lamps and to electrical compartment junction 38. Junction 38 is connected to lavatory lamp and relay coil. When relay coil is energized, current from circuit breaker number 6 is routed through relay contacts, then to "SOL" terminal of lavatory control relay. Lavatory control relay "SOL" terminal is connected to ventilating fan through electrical compartment junction 9 and a 6-amp line fuse.

WATER PUMP RELAY

Water pump relay, mounted in heating and ventilation compartment, carries current to operate the water pump whenever pump is operated; either by the defroster switch or by the water pump switch. Electrical circuits and connections are shown on "Heating and Air Conditioning Wiring Diagram." Operation of water pump is as follows:

Operated By Defroster Switch. The circuit for water pump, when operated by defroster switch is from either "HI" or "LO" position of defroster switch to driver's control panel junction 44 or 54. Junction is determined by position of switch - 44 is "HI" position, 54 is "LO" position. From junction 44 or 45, circuit is connected to driver's control panel junction 64 through a rectifier for each circuit. Driver's control panel junction 64 is connected to electrical compartment junction 6, then to "N.O." contact of modulating valve switch which is held in this position except when system is calling for heat. From here, current is supplied through a rectifier, then to water pump relay terminal "VAC." energizing relay contacts. With relay contacts closed, current is supplied from ventilation compartment battery junction to "BATT" terminal of relay, through relay contacts, then out relay terminal "SOL." Relay "SOL" terminal is connected to water pump through a 15-amp circuit breaker.

Operated By Water Pump Switch. The circuit for water pump when operated by water pump switch is from driver's control panel junction 42 (shown on "Engine Control and Generator Wiring Diagram") to electrical compartment junction 42. Electrical compartment junction 42 supplies relay energizing current to water pump switch. When switch is closed, current is supplied to relay terminal "VAC." through electrical compartment junction 44 and ventilation compartment junction 3. Current to water pump motor through relay is the same as when operated by defroster switch.

ENGINE TEMPERATURE SWITCH RELAY

This relay is used on vehicles equipped with a mercury tube type engine temperature switch. Relay is mounted in electrical compartment (10, fig. 6). Relay circuits and connections are shown on "Engine Control and Generator Wiring Diagram."

This relay is required because the mercury tube type temperature switch does not draw enough current to actuate the engine shut-off time delay relay. The temperature switch current draw energizes the relay operating coil, closing the relay contacts; battery circuit is then complete through the relay contacts to the time delay relay heating element. Refer to "Automatic Engine Shut-off System" earlier in this section for operation of this system.

RELAY 1850547

This relay is used as a stop light tell-tale relay. Relay is mounted in electrical compartment junction box (7, fig. 6) at rear of coach. Relay circuits are shown on "Stop and Directional Light Wiring Diagram - MD 88755."

Relay is connected into the stop light and stop light switch circuit in such a manner that when the brakes are applied and stop light switch contacts close, current to stop lights passes through the relay coil winding. With coil winding energized,

armature is attracted to core and relay points close, completing the circuit to the "STOP" tell-tale on gauge and tell-tale panel, indicating that the stop lights are illuminated.

Stop light tell-tale relay is sensitive to amperage, requiring the current draw of both stop light bulbs to close the points. If one bulb is burned out, current draw will not be sufficient to close the relay points, and stop light tell-tale will not illuminate when brakes are applied. When the directional signal lights are being used and brakes are applied, one bulb is intermittently taken out of the circuit to produce the directional signal. To prevent relay points from opening under these conditions, a resistor, installed in driver's control panel at left of driver (9, fig. 4), is connected into the flasher circuit in such a manner that the resistor is placed into the circuit when the stop light bulb is taken out by the flasher. This provides constant current draw sufficient to keep the relay points closed.

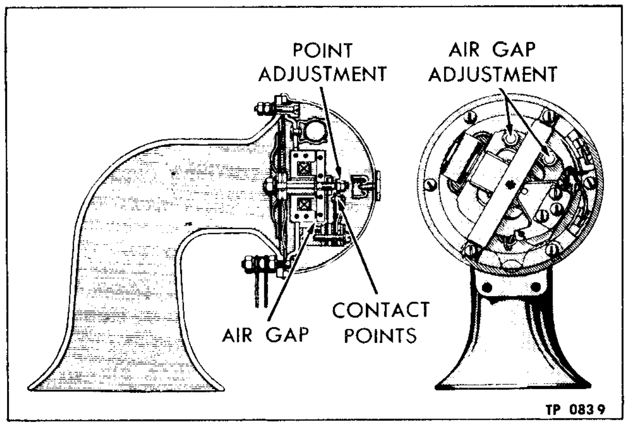


Figure 14—Electric Horn

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing amperage.

Air Gap (Fig. 12)

Remove relay cover. Press armature down until points just close and measure air gap between armature and core. Adjust, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and the armature.

Point Opening (Fig. 12)

Measure contact point opening with armature up against stop. Adjust opening, if necessary, by bending the armature stop.

Closing Current (Fig. 12)

Connect an accurate ammeter and a variable resistance unit in series with the operating circuit at the "S" terminal. Apply brakes, or connect a jumper lead across the stop light switch points to complete the circuit. Slowly decrease resistance until points close and note reading on ammeter. Increase resistance until points open and note reading on ammeter. If closing and opening amperage is not within limits listed in "Specifications" adjust by bending armature spring post to increase or decrease spring tension. Increasing spring tension increases closing amperage, and decreasing spring tension decreases closing amperage.

If relay does not function properly during normal operation in vehicle, candlepower of stop light bulbs should be checked. Stop light bulbs of proper size must be used.

ELECTRIC HORN

Horn (fig. 14) operates on magnetic principle to produce warning signal. Current from battery flows through windings within horn when circuit is completed by action of a relay when horn button is pressed. Horn circuit is protected by number 22 circuit breaker in driver's control panel at left of driver. Refer to "Alarm and Signal Wiring Diagram" for horn circuit.

HORN TESTS

If horn produces a weak signal, voltage at horn should be checked by connecting a voltmeter across horn terminals. The voltage reading should not be less than 11 volts. A lower reading indicates either a low battery or high resistance in horn circuit.

Loose or corroded connections in horn circuit should be corrected. Check for defective wiring by connecting test leads from horn to battery.

A loose connection or poor contact at horn push button may cause horn to operate intermittently. Shunt around horn button to determine whether there is poor contact at push button. Whenever wiring is replaced in horn circuit, use correct size as shown on wiring diagram.

Horns usually have a rasping sound when vital parts are broken or loose. A loose back shell may affect tone. Tighten collar screws, mounting nuts, and studs. Replace all damaged parts.

The horn will not function properly if field windings within horn are open circuited or grounded. Connect an ammeter in circuit at horn terminal. If there is no indication of current flowing when contact points are closed, windings are open circuited. The ammeter will indicate an excessive flow of current if windings are short circuited or grounded.

Windings may also be checked for grounded circuit with test lamp having its own source of current. Disconnect horn leads and touch one test point to one of the horn terminals and the other point to the horn base. If lamp lights, field windings are grounded.

Excessive arcing at contact points may be caused by improper current adjustment. An open circuit in condenser will cause excessive arcing at points and, in some cases, contacts will be held together.

HORN ADJUSTMENTS

If tone is not satisfactory after checking preceding conditions, adjust horn in following manner:

1. Remove shell from horn.
2. Connect ammeter in circuit at horn and adjust current consumption by varying position of adjusting nut. Refer to "Specifications" at end of this group for current consumption.
3. Loosen adjusting lock nut and turn adjusting nut to left or right to increase or decrease current.
4. Too much current will cause horn to have a sputtering sound. This adjustment is very sensitive. Move nut 1/10 turn at a time and lock in position each time before trying. If ammeter is not available, adjust according to sound.
5. Correct air gap between armature and core is important for proper tone. The gap must be uniform across entire surface of armature. Width of gap may be determined by using a feeler gauge. Adjustments are made by use of air gap adjusting nuts. Refer to "Specifications" at end of this group for correct adjustment dimensions.

ELECTRIC SPEEDOMETER

The electric drive unit is mounted on transmission and is driven by a short flexible cable from the transmission speedometer drive gears. A four wire conductor cable plugged into drive unit is connected to an electric motor unit mounted on back of mechanical speedometer head in instrument panel. Electric motor drives speedometer when actuated by electrical impulses from drive unit. Drive unit uses 12 volt current from battery or generator. Circuit is protected by number 3 circuit breaker in driver's control panel and is operative when "MASTER" switch is in "DAY" or "NITE" position.

Electric speedometer wiring is shown on "Speedometer Wiring Diagram."

Current is divided in drive unit by a mechanically driven rotor with two brushes which run against a resistor ring. Varying currents are transmitted to motor on speedometer head through a four wire cable.

Electrical currents from drive unit energize two pairs of coils in motor unit, causing magnetic rotor to rotate at exactly same speed as mechanically driven unit. Since motor is coupled to speedometer head, rotation is transformed to a reading on face of calibrated speedometer head. Thus, a synchronized electrical drive supplants the standard drive cable.

TESTING

For testing speedometer electrical units (using battery of 12 volts), plus or minus one volt variation is permissible. The maximum current consumption should not exceed two amperes.

Jam nut, located at point where four wire conduit fastens to connector plugs, should always be kept tight. The connector plug body grips cable insulation and prevents conduit coming loose from connector plugs due to rough handling which would cause loose connections.

A test light (1568147) should be used to test electric speedometer. If speedometer ceases to function, proceed as follows:

1. Check test light bulbs with battery to be sure they are not burned out.
2. Pull four-contact plug out of top of drive unit and insert plug on end of light cable in its place.
3. Turn "MASTER" switch to "DAY" position to energize drive unit.
4. Disconnect flexible drive shaft at transmission. Turn drive shaft slowly by hand. If lights alternately grow bright and dim, the drive unit is functioning properly.
5. Remove test light cable plug from drive unit and reconnect cable to drive unit.
6. Disconnect cable plug from speedometer head motor and connect to test light cable, using double end male adapter chained to end of cable.
7. Again turn drive shaft slowly by hand. If lights alternately go bright and dim, wiring between drive unit and head is good and trouble should be in head unit.
8. Always be sure that plugs make good contact when connected.
9. If lights fail to check when connected to unit, check feed and ground connections at drive unit for tightness; also for broken flexible drive shaft.
10. If lights check when connected to drive unit but not when connected at front of cable, careful check should be made of electrical cable for broken wire or loosen connections where wires attach to sockets.

With above procedure, it will be easy to determine whether trouble lies in drive unit, in con-

nector plug and wiring, between drive unit and motor unit, or in motor unit and speedometer head assembly.

NOTE: If speedometer test fixture with master head is available, the speedometer can be tested with master speedometer reading 60 miles per hour. If speedometer calibration is not satisfactory when speedometer is driven mechanically, head may be recalibrated by an authorized United Motors Service Station. Speedometer calibration discrepancies have no connection with the electric drive unit, providing the speedometer head and motor unit are not binding, which is easily discovered by excessive pointer fluctuations.

RADIO AND PUBLIC ADDRESS SYSTEM

The radio and public address system, used as special equipment on some coaches, consists primarily of an antenna, radio receiver unit, P.A. system amplifier, remote control switch, radio and P.A. selector switch and speaker. Some coaches may have radio only or public address system only. "Radio and Public Address System Wiring Diagram - MD 89110" shows installation circuits for both radio and public address system. When only one system is installed, use portion of wiring diagram that is applicable. Both radio and P.A. system circuits are protected by number 24 circuit breaker in driver's control panel junction box. Refer to paragraphs below for individual systems.

RADIO

Radio antenna, mounted on left-front corner of coach roof, is held in horizontal position with insulated hold-down clamps. Radio receiver unit is mounted on left-side baggage rack and is controlled either by remote control switch on driver's control panel or by controls on front of radio unit. Radio and P.A. system selector switch, mounted on rear end of driver's control panel box, must be in "RADIO" position before receiver unit is operative. Speaker(s) are mounted in coach roof or in radio unit. In addition to number 24 circuit breaker in driver's control panel junction box, radio is protected by a 9 amp fuse in power circuit. Troubles within installation wiring and switches can be checked with a test lamp or ohmmeter. Internal troubles within radio unit should be corrected by an authorized radio technician.

PUBLIC ADDRESS SYSTEM

Public address system amplifier is mounted at right of driver below I.C.C. brake valve. System is operative when radio and P.A. system selector switch is in "P.A." position and microphone switch is pressed. Volume is controlled by knob extending from end of amplifier unit. Installation troubles can be checked with a test light or ohmmeter. Refer to wiring diagram. Internal troubles within amplifier should be corrected by an authorized radio technician.

SPECIFICATIONS

FUSE

Speedometer Drive Unit Line Fuse	6 amp.
Floor Blower Line Fuse	6 amp.
Lavatory Ventilating Fan Line Fuse	6 amp.

CIRCUIT BREAKERS

Make	F. A. Smith Mfg. Co.
Type	Automatic Reset
Amperage Rating	Refer to figures 5 and 7

RELAYS

(Refer to Table previously in this section for relay application.)

1115810

Make	Delco-Remy
Small Unit (Starter Relay)	
Air Gap (points closed)	0.011" Min.
Point Opening	0.025"
Closing Voltage Range	8.3-10.2
Opening Voltage	3.2 Max.
Sealing Voltage	10.7 Max.
Large Unit (Generator Relay)	
Air Gap (points closed)	0.011"-0.016"
Point Opening	0.023
Closing Voltage Range	3.3-4.2
Sealing Voltage	0-0.9 Above Closing

1116797

Make	Delco-Remy
Air Gap (points closed)	0.012"
Point Opening	0.020"
Closing Voltage Range	7.0-9.0

1116818

Make	Delco-Remy
Air Gap (points closed)	0.022"
Point Opening	0.030"
Closing Voltage Range	6.0-8.0
Sealing Voltage	11.0 Max.

1116852

Make	Delco-Remy
Air Gap (points closed)	0.022"
Point Opening	0.030"
Closing Voltage	7.0 Min.
Sealing Voltage	9.0 Max.

1850547

Make	Delco-Remy
Model	268-H
Air Gap (points closed)	0.015"
Point Opening	0.020"
Closing Current (Amps.)	2.35 Max.
Opening Current (Amps.)	1.5 Min.

MAGNETIC SWITCH

1114223

Make	Delco-Remy
Voltage	12

ALARM BUZZER AND RECTIFIER ASSEMBLY

Make	Delco-Remy
Model	1116981
Point Opening	0.015"
Adjust to Buzz at	0.30-0.35 amps. at 13.5-14.5 volts.

LAVATORY EMERGENCY AND HAND BRAKE ALARM BUZZERS

Make	Delco-Remy
Models	
Lavatory Emergency	1116882
Hand Brake Alarm	1115802
Point Opening	0.017
Adjust to Buzz at	0.25-0.35 amps. at 13.5-14.5 volts

HORN

Make	Delco-Remy
Model	1999700
Voltage	12
Air Gap	0.030"-0.034"
Current	3.5-5.5 amps.
Frequency	300-320

SPEEDOMETER

Make	AC Spark Plug Div.
Model	1587607

SPEEDOMETER DRIVE UNIT

Make	AC Spark Plug Div.
Model	1580697

Refer to back of book
for Wiring Diagrams.

Batteries

GENERAL

Two 12-volt batteries, connected parallel, are mounted in battery compartment located ahead of left rear wheelhouse. Two spring-loaded pull-type latch handles are located at bottom of door. To open door, pull latch handles outward and disengage from door; lift door to open position, disengage door prop from clip on door, and engage prop in bracket on body. To close door, raise door slightly and disengage prop from bracket on body, secure prop in clip on door, then lower door. Pull out on latch handles and engage catches at bottom of door. View of batteries installed is shown in figure 1.

IMPORTANT: Observe decal on inside of battery compartment door which reads: CAUTION NEGATIVE GROUND. It must be emphasized that if the batteries are not connected NEGATIVE GROUND, severe damage to the generator, regulator, batteries, and battery cables will result.

The battery has three major functions to perform on the vehicle:

1. It provides a source of current for starting the engine.
2. It acts as a stabilizer to the voltage in the electrical system.
3. It can for a limited time furnish current when the electrical demands of the electrical equipment exceed the output of the generator.

BATTERY DISCONNECT

When it is necessary to remove battery power from vehicle, disconnect battery positive (+) cable as shown in figure 2. On some vehicles, two positive (+) cables must be disconnected.

CAUTION: After cables have been disconnected, wrap terminals with electrical tape or equivalent.

ON VEHICLE SERVICE

FILLING BATTERY

Electrolyte level in the battery should be checked at least every 1,000 miles or once every two weeks. If the electrolyte level is found to be low, water should be added to each cell until the level rises to the bottom of the vent well. DO NOT OVERFILL!

NOTE: Level of electrolyte can be checked by the use of a flashlight and mirror. Hold mirror over each cell opening and direct flashlight beam so electrolyte level can be seen.

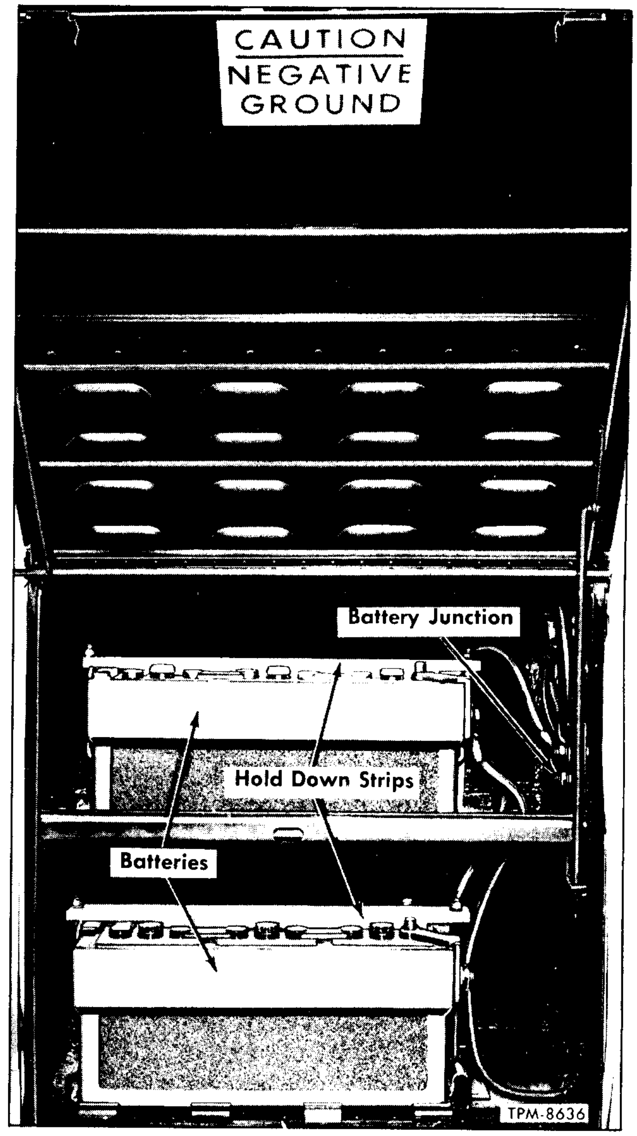


Figure 1—Batteries Installed

Distilled water or water passed through a "demineralizer" should be used to eliminate the possibility of harmful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life. DO NOT ADD ANY SUBSTANCE TO THE ELECTROLYTE EXCEPT WATER.

CLEANING AND INSPECTION

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the bat-

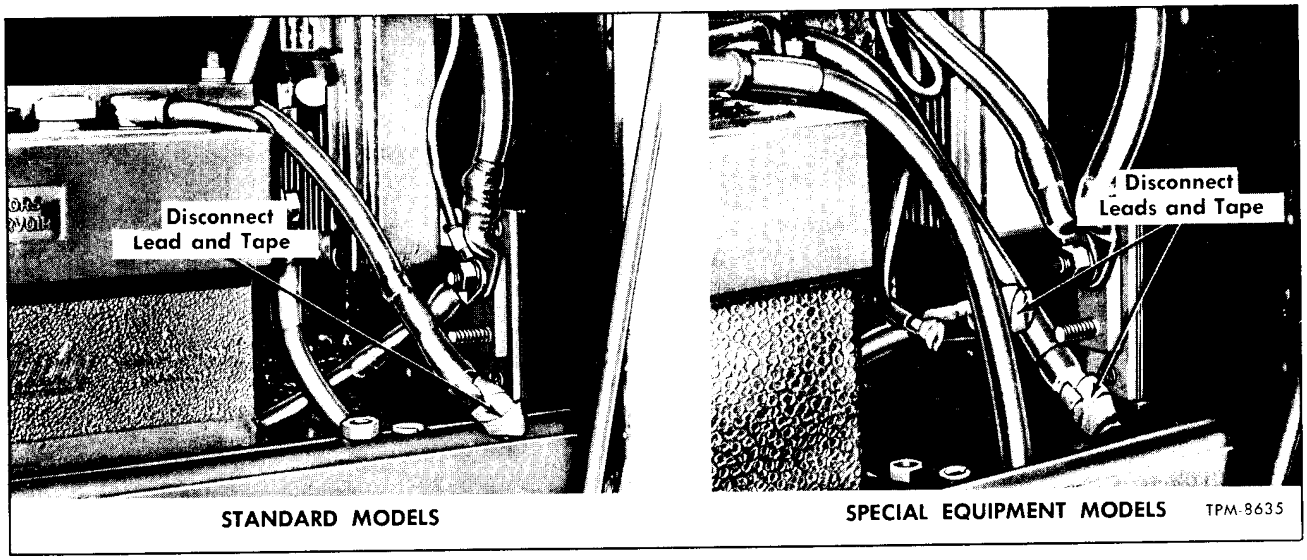


Figure 2—Battery Disconnect

tery hold-down bolts should be kept properly tightened. For best results when cleaning battery, wash first with a dilute solution of ammonia or soda to neutralize any acid present, then flush off with clean water. Care must be used to keep vent plugs tight so that the neutralizing solution does not enter the cells. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder, but they should not be tightened sufficiently to place a strain on the battery case.

To insure good contact, the battery cable clamps should be tight on the battery posts. If the posts or cable clamps are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install clamps on battery posts and tighten firmly, then coat posts and clamps with petroleum jelly to help retard corrosion.

ON VEHICLE TESTS

Three battery checks are described below to determine condition of battery.

1. Hydrometer test.
2. Capacity test.
3. Three minute test.

If a battery failure is encountered the cause may be outside the battery itself. Do not be satisfied to merely recharge or replace battery. Find cause of failure and prevent recurrence of trouble.

NOTE: In some cases, it may be necessary to remove batteries from vehicle to obtain the necessary working space for the following checks.

HYDROMETER TEST

The hydrometer test is merely a means of determining the state of charge of the battery. This test will not necessarily indicate whether the battery is able to perform its normal functions.

1. Measure specific gravity of electrolyte in each battery cell. The hydrometer tube must be held vertically. Do not draw too much electrolyte into the hydrometer. The float must be freely suspended in the electrolyte and the reading taken at eye level. If water has been recently added to the cells, or battery fast charged, the hydrometer reading will be false.

2. Correct hydrometer reading for temperature. When electrolyte temperature is above 80 degrees F., add 4 points (.004) to reading for each 10 degrees above 80. If electrolyte temperature is below 80 degrees F., subtract 4 points for each 10 degrees below 80.

3. a. If the specific gravity readings are 1.215-1.270 at 80 degrees F., and variation between cells is less than 25 gravity points (.025), the battery presumably is at least 3/4 charged and in good condition for further use or testing of engine electrical circuits.

b. If the specific gravity readings are below 1.215 and the variation between cells is less than 25 gravity points, the battery presumably is in sound condition, but its state of charge is too low for further use or testing electrical circuits.

c. If the specific gravity readings show a variation between cells of more than 25 gravity points, an unsatisfactory battery condition is indicated which may be caused by shorted cells, acid loss, or a worn out battery.

To determine whether a battery is a good battery, regardless of its state of charge, proceed with the "Capacity Test" below:

CAPACITY TEST

This test is one means of determining whether a battery is functioning efficiently to the degree where it can be relied upon to perform all of its duties properly in the vehicle.

A battery that will maintain 9.0 volts or better during a capacity test should be considered a good battery. To make this test, use equipment that will take a heavy electrical load from the battery such as a carbon pile or other suitable means. If test equipment is not available for loading battery, the starter may be used as a load.

1. Connect positive voltmeter and ammeter leads to battery positive post and negative voltmeter and ammeter leads to battery negative post (fig. 3). NOTE: Ammeter cable clips must contact battery posts; voltmeter cable clips must contact battery post or cable clamp, not the ammeter cable clips.

2. Apply a load to the battery of three times the ampere-hour rating of the battery for 15 seconds. Refer to "Specifications" at end of this section for ampere-hour ratings.

3. With ammeter reading specified load, read voltage which should not be less than 9.0 volts.

a. If voltmeter shows 9.0 volts or more, battery has good output capacity and will readily accept a normal charge.

(1) If specific gravity is 1.215 or more, no service is required.

(2) If specific gravity is below 1.215, check charging circuit to determine the cause and correct as required. The battery should be slow-charged for city driving. With highway driving and a good charging system, the battery should charge satisfactorily.

b. If voltmeter shows a reading of less than 9.0 volts, proceed with the "Three-Minute Test" described below:

THREE-MINUTE TEST

In cases where voltage of less than 9.0 volts is obtained in the "Capacity Test" described above, an accurate test using a voltmeter and a fast charger will quickly establish whether a battery is good or bad, even when a battery is in a discharged condition.

This procedure determines the condition of charged or discharged batteries by following the principles that:

a. A charged battery may be tested by taking current out of it.

b. A discharged battery may be tested by passing current through it.

NOTE: This test should not be used if battery temperature is below 60 degrees F.

If battery temperature is above 60 degrees F., add battery water, if necessary, and proceed with three-minute test.

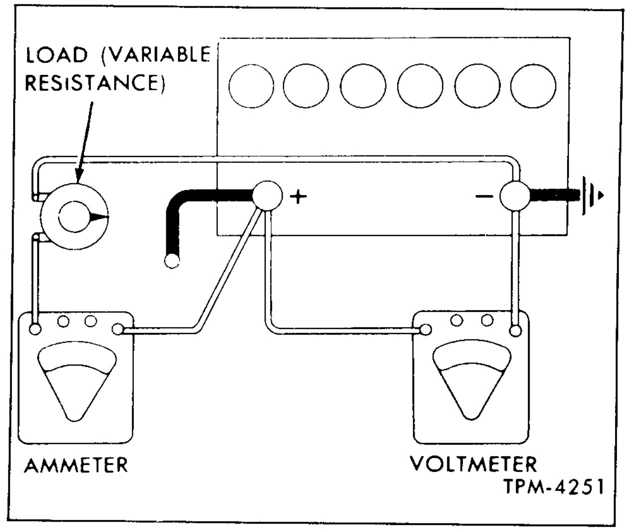


Figure 3—Battery Capacity Test (Typical Hook-Up)

CAUTION: Do not make this test, which is recommended for discharged batteries, if voltage obtained in "Capacity Test" is 9.0 volts. A charged battery will not accept 40 amperes without an excessively high voltage.

Test Procedure

If voltage obtained in "Capacity Test" was less than 9.0 volts, fast charge battery at 40 amperes for 3 minutes. Then, with fast charger still operating, test individual cell voltage of battery.

NOTE: On some batteries the cell connectors are not exposed, therefore, it may be necessary to pierce the cover to contact connector straps to obtain individual cell voltages.

a. If cell voltages are uneven by more than 0.1 volt, replace battery.

b. If all voltages are even within 0.1 volt, test total battery voltage with charger still operating on fast charge.

NOTE: If total voltage is over 15.5 volts, battery is unsatisfactory and is probably sulfated. Battery may be serviceable after a continued slow charge process as outlined under "Charging" in this section. After charging, perform "Capacity Test" as outlined above. If reading is above 9.0 volts, place back in service. If below, replace battery.

CHARGING

Batteries removed from the vehicle for charging should be charged continuously at a low rate until fully charged. Batteries may be safely slow-charged at a rate in amperes equal to 7% of the battery's ampere-hour capacity. (Refer to "Speci-

BATTERIES

fications" at end of this section for ampere-hour rating of batteries used.) This is called the "normal" charge rate. The battery is fully charged when specific gravity readings taken at hourly intervals show no increase during three consecutive readings.

A very low rate -- not more than one-half the normal charging rate -- should be used for charging a sulfated battery. In the case of badly sulfated batteries, as much as 100 hours of charging time may be required before the battery becomes fully charged. Badly sulfated batteries may require a continuous slow charge for 48 hours or more before a rise in gravity reading occurs. If the specific gravity reading of any cell fails to reach 1.250 (corrected to 80°F.) or if there is a variation of more than 25 gravity points between cells after thorough slow charging, replace the battery.

Although the slow-charge method is recommended for charging all batteries, discharged batteries in otherwise good condition (refer to "Battery Capacity Test") may be given a boost with a quick charger if time does not permit complete slow charging. When using a quick charger, it must be remembered that the battery is only receiving a partial charge and that the battery electrolyte temperature must not be allowed to exceed 130°F. If the battery heats up excessively, quick charging must be discontinued.

BATTERY CABLES

Check cable leads and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces abnormal voltage drop which may lower voltage at starting motor to such a low value that normal operation of starting motor will not be obtained. Abnormal voltage drop can be detected with a low reading voltmeter as follows:

NOTE: To prevent engine from starting, place "ENGINE CONTROL" switch in engine compartment in "OFF" position.

1. Check voltage drop between grounded (negative) battery terminal and vehicle frame. Place one prod of voltmeter on battery terminal and other on vehicle frame. With starting motor cranking engine at normal room temperature (70°F.), voltage reading should be less than 0.3 volts. If more than this, there is excessive resistance in this circuit.

2. Check voltage drop between ungrounded (positive) battery terminal and starting motor terminal stud while motor is operated. If reading is more than one (1.0) volt, there is excessive resistance in circuit. NOTE: If necessary to extend wire from meter for this test, use No. 16 or larger wire.

3. Check voltage drop between starting motor housing and vehicle frame. This must be less than 0.1 volt.

SPECIFICATIONS

Make	Delco-Remy
Model	8DR205
Quantity	2, Connected Parallel
Approx. Weight Filled	153 lbs.
Voltage	12
Plates per Cell	27
Amp. Hr. Capacity @ 20 Hr. Rate	205

Starting System

GENERAL

The starting system includes batteries, starter, starter solenoid, starter relay (incorporated in starter control and generator relay), starter switches, circuit breakers, and interconnecting wiring and cables. Starting system control circuits are shown on "Engine Control and Generator Wiring Diagram." Refer to "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section for information on all relays.

CONTROL SYSTEM OPERATION

Starter control system is operative when "MASTER" switch on driver's control panel is placed in "DAY" or "NITE" position. Although starter motor can be operated with "MASTER" switch in "NITE" position, it is recommended to operate starter motor in "DAY" position only. This will prevent an excessive current draw from battery due to lighting equipment. Before starter motor can be energized with starter switch, the rear start and engine control switches (fig. 1) on engine compartment control panel must be in "NORMAL" position.

When starter switch is closed, circuit is completed through operating coil of starter relay portion of starter control and generator relay, causing the lower contacts of the relay to close. Battery current then flows from number 6 terminal through the closed lower contacts of the starter relay to the operating coil of the starter solenoid. With solenoid operating coil energized, circuit is completed direct from battery to starter.

On coaches equipped with automatic engine shut-off system, circuit from "MASTER" or "ENGINE CONTROL" switch to engine stop solenoid valve is routed through the normally closed contacts of the engine stop time delay relay. If engine fails to start within 20 seconds after circuit is energized, the time delay relay contacts will open; "MASTER" or "ENGINE CONTROL" switch must then be momentarily returned to "OFF" position to permit the time-delay relay to reset itself and close the contacts.

CAUTION: When performing maintenance in engine compartment, place rear start or engine control switch in "OFF" position to prevent someone from starting engine with starter switch on driver's control panel.

When starting engine from rear controls, make sure transmission is in neutral position and hand brakes are applied.

STARTER

DESCRIPTION

Starter (fig. 2) is a heavy duty unit, solenoid operated through an enclosed shift lever. Starter is equipped with a heavy duty sprag type overrunning clutch. A removable plug is provided in shift lever housing to permit adjustment of pinion clearance.

Armature shaft is supported in bronze bushings at three points -- in commutator end frame, in shift lever housing, and in nose housing. Positive lubrication is provided at each bushing by an oil saturated wick that projects through the bushing and contacts the armature shaft. A waste-filled oil reservoir for each wick provides a large oil supply.

O-ring seals are used between commutator end frame and field frame, and between shift lever housing and field frame. A spring-loaded lip type oil seal together with an O-ring seal in shift lever housing and a boot over the solenoid plunger prevent entry of transmission oil into the armature, field coils, and solenoid case.

Two brushes are carried in each of four holders mounted on plates which are attached to, but insulated from, the commutator end frame. As shown on wiring diagrams (fig. 3), two sets of brushes connect to the ground terminal stud on commutator end frame; these connections are made through the brush holder mounting plate. The other two sets of brushes, which are insulated from the mounting plate, connect to the field coil leads.

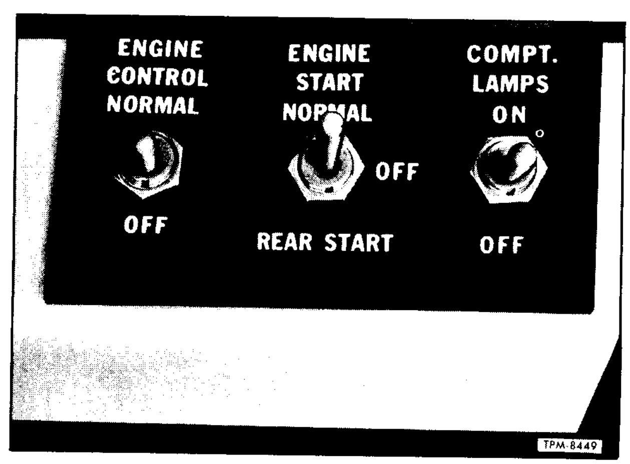


Figure 1—Engine Rear Control Panel

STARTING SYSTEM

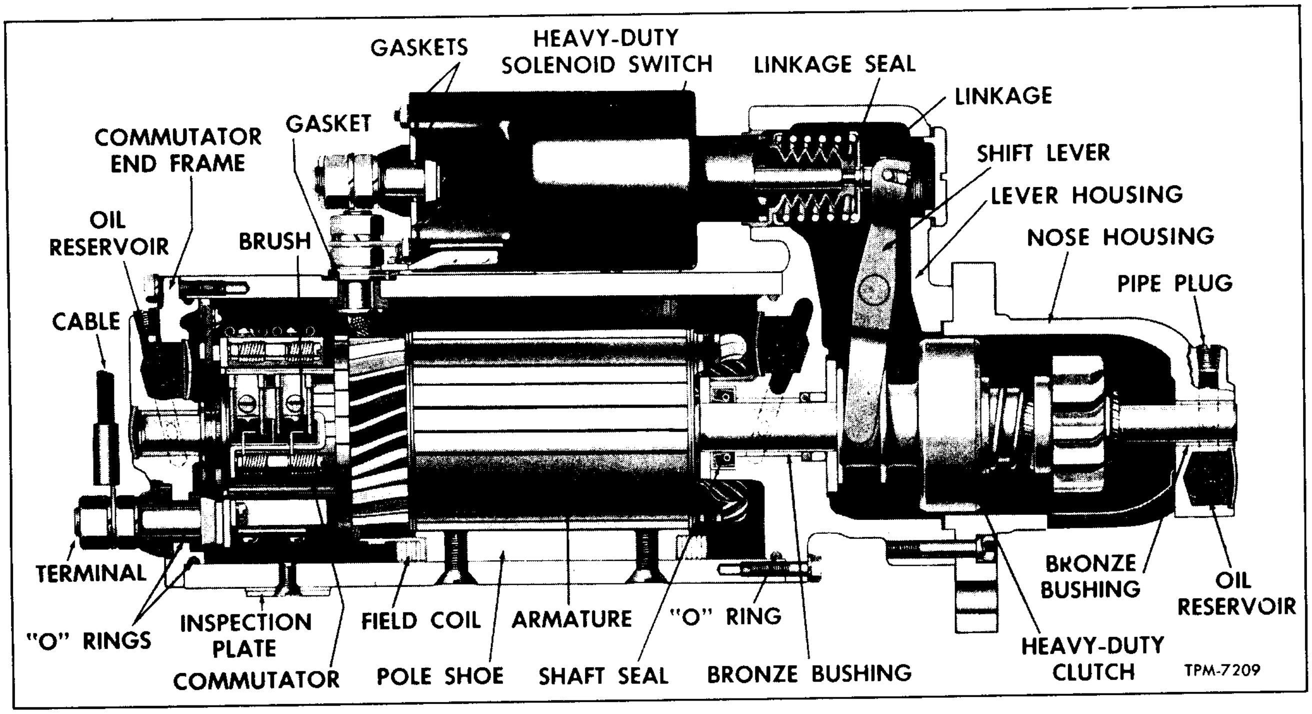


Figure 2—Starter and Solenoid Assembly

STARTER DRIVE OPERATION

When starter circuit is energized, shift lever operated by solenoid slides the pinion into mesh with flywheel ring gear teeth. The rotary motion between pinion and ring gear, provided by the spiral splines on clutch shaft, normally relieves tooth abutment on the first attempt. A protective sleeve located on spiral spline acts as a stop for the pinion when extreme tooth abutment occurs. This limits the clutch travel, preventing the switch contacts in solenoid from closing. Therefore, armature cannot rotate before pinion is engaged properly. Spinning and subsequent damage to pinion and ring gear is eliminated. A second attempt to engage rotates pinion enough to assure proper engagement.

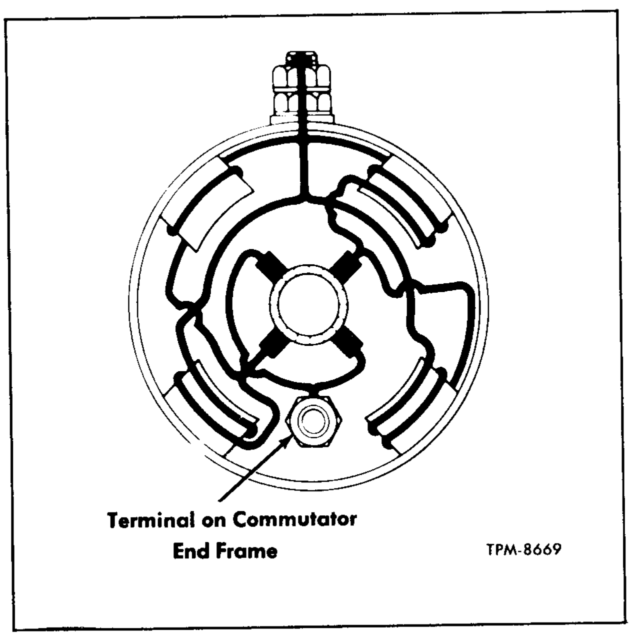


Figure 3—Starter Internal Wiring Diagram

MAINTENANCE

Other than periodic lubrication as directed in LUBRICATION (SEC. 13) and keeping cable connections clean and tight, starter should require no periodic maintenance.

STARTER REPLACEMENT

REMOVAL

1. Gain access to starter by removing middle access panel on engine compartment bulkhead.
2. Disconnect two cables from starter terminals.
3. Remove starter to flywheel housing attaching parts and remove starter through access hole.

INSTALLATION

1. Position starter in proper location on flywheel housing.
2. Install starter attaching parts.

3. Connect starter cables and install access panel to engine compartment bulkhead.

STARTER FREE SPEED CHECK

Before disassembling starter, the following check of starter operation can be made to determine conditions which may require special attention during overhaul.

To make this check, connect an ammeter in series with the positive (+) terminal of a 12-volt battery and the "BAT" terminal of the starter solenoid (fig. 4). For the return circuit, connect a lead from the starter frame to the battery negative (-) terminal. Connect a voltmeter from solenoid "BAT" terminal to ground on starter frame.

Use a tachometer at end of armature shaft (fig. 4) to determine armature rpm. Energize the solenoid by connecting a jumper lead from the solenoid "BAT" terminal to the solenoid switch terminal. Observe the armature rpm, voltage, and current draw. Failure of starter to operate according to values listed in "Specifications" at end of this section may be due to tight or dry bearings, or to high resistance connections.

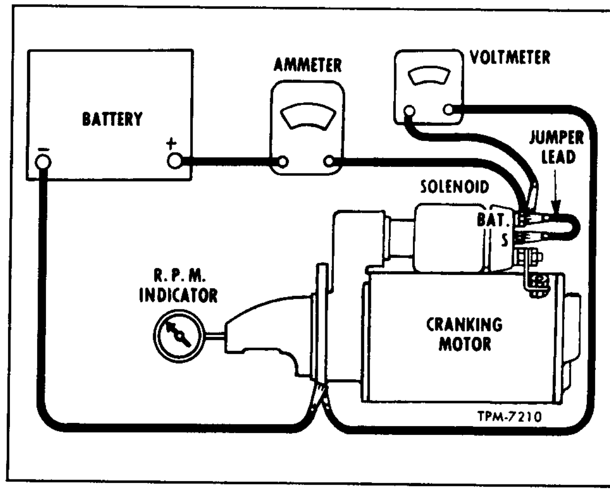


Figure 4—Test Hook-Up For Checking Starter Free Speed

STARTER DISASSEMBLY
(Refer to Figure 2)

1. Using a prick punch or small chisel, mark relative positions of commutator end frame and shift lever housing to field frame, and position of nose housing to shift lever housing so they can be reassembled in same positions.
2. Remove nut and lock washer attaching solenoid "MOTOR" terminal connector strap to terminal stud on field frame. Also disconnect solenoid ground lead from terminal stud on commutator end frame.
3. Remove plug and gasket from shift lever housing. Remove nut and guide from end of solenoid plunger rod, then remove solenoid assembly from field frame and shift lever housing.
4. Remove six socket-head screws attaching nose housing to shift lever housing. Remove nose housing from lever housing and armature shaft.
5. Remove inspection hole cover plates from commutator end of field frame. Disconnect field coil leads from brush holders.
6. Remove bolts and lock washers attaching commutator end frame to field frame. Remove commutator end frame assembly from field frame and armature shaft. Remove thrust washer from armature shaft.
7. Remove bolts and lock washers attaching shift lever housing to field frame. Separate field frame from shift lever housing and remove field frame from armature.
8. Withdraw armature from shift lever housing, removing drive clutch assembly from armature shaft as armature is removed. Remove brake washer from armature shaft, and remove collar and O-ring from counterbore in shift lever housing.
9. It is not necessary to further disassemble starter unless parts require replacement as directed later under "Inspection, Tests, and Repair."

INSPECTION, TESTS, AND REPAIR
(Refer to Figure 2)

The overrunning clutch assembly, armature and field frame and coil assembly should not be cleaned in a degreasing tank or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and damage the insulation in the armature and field coils. All parts except the clutch should be cleaned with oleum spirits and a brush. The clutch should be wiped with a clean cloth. Commutator can be cleaned with No. 00 sandpaper. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR.

ARMATURE

If the armature commutator is worn, dirty, out-of-round, or has high insulation, the armature should be placed in a lathe and the commutator turned down. Do not cut deeper than necessary to remove rough spots or out-of-round condition. The insulation between the commutator segments should then be undercut 1/32" wide and 1/32" deep, and the slots cleaned out to remove dirt or copper dust. As a final step, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs formed by the undercutting.

The armature should be checked for open circuit, short circuit, and grounds as follows:

Open Circuit Test

Open circuits are usually caused by excessively long cranking periods. The most likely place for an open circuit to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections. Poor connections cause arcing and burning of commutator bars. If bars are not too badly burned, repairs can sometimes be made by resoldering the leads in the riser bars, using rosin flux solder. After soldering, turn down commutator and undercut the insulation.

Short Circuit Test

Short circuits in the armature are located by the use of a growler. When armature is rotated in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located (fig. 5). Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.

Ground Test

Grounds in the armature can be detected with a 110-volt test lamp and test points. If the lamp lights with one test point on commutator and the other on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure, which is often brought about by overheating due to excessively long cranking periods, or by accumulation of brush dust between the commutator bars and the steel commutator ring.

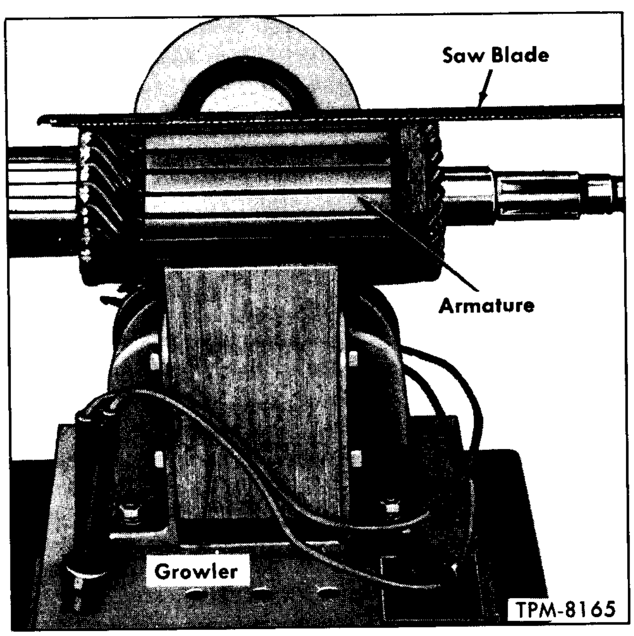


Figure 5--Checking Armature For Short Circuit

FIELD COILS

Internal wiring circuits are shown in figure 3.

Connect one test lamp lead to the field frame and the other to the terminal stud on the field frame. If lamp lights, at least one of the field coils is grounded and it must be repaired or replaced.

Connect one test lamp lead to the terminal stud on field frame and the other, in turn, to each of the field coil leads which connect to the brush holders; lamp should light. If lamp fails to light in either case, the field coils are open.

Field Coil Replacement

Field coils can be removed from the field frame by using a pole shoe screwdriver. A pole shoe spreader should also be used to prevent distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding the field coils as the pole shoes are tightened into place. Each pole shoe has a long lip on one side and short lip on the other; they should be installed with the long lip pointing in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

COMMUTATOR END FRAME

Remove all brushes. Place one test lamp lead on end frame, and the other, in turn, on each of the brush holders and on terminal stud. If lamp lights it is an indication of defective brush holder insulation or terminal insulators. Replace defective insulators under brush holder mounting plates or at terminal stud.

If brushes are worn down to less than one-half their original length, they must be replaced (original length is 3/4"). Be sure leads are secure in brushes and that clips are properly soldered to leads.

Check brush spring tension. If not within limits listed in "Specifications" at end of this section, replace with new springs. Examine brush holders and hinge pins for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

Examine bushing in end frame for excessive wear or out-of-round condition. Original diameter of bushing is listed in "Specifications" at end of this section. Replace bushing, if necessary, as directed below.

Bushing Replacement

1. Remove expansion plug from armature shaft bore.

2. Remove expansion plug from oil reservoir and remove pipe plug from oil wick passage. Remove packing from oil reservoir and remove oil wick.

3. Press old bushing from end frame and press new bushing into place.

4. Using a drill same size as oil wick passage, run drill through passage to cut through edge of bushing. Remove burrs from bushing caused by drilling operation.

5. Install new oil wick and fill oil reservoir with fine wool packing material. Saturate reservoir packing and oil wick with engine oil, then install new expansion plug with gasket in oil reservoir opening.

6. Install new expansion plug with gasket in armature shaft bore in end frame.

SHIFT LEVER HOUSING

Inspect oil seal and bushing in shift lever housing for evidence of damage or excessive wear. Original diameter of bushing is listed in "Specifications" at end of this section. Replace bushing, if necessary, as directed in "Bushing Replacement" under "Commutator End Frame," omitting steps 1 and 6. When installing new oil seal, lip must point inward.

If shift lever appears excessively loose on lever shaft, worn parts can be replaced by removing retaining ring from exposed small end of lever shaft, then driving shaft out of housing. When installing lever and shaft, use new O-rings in grooves in shaft.

NOSE HOUSING

Inspect bushing in nose housing for wear, referring to "Specifications" for original bushing diameter. Replace bushing, if necessary, as directed in "Bushing Replacement" under "Commutator End Frame," omitting steps 1 and 6.

OVERRUNNING CLUTCH ASSEMBLY

Drive pinion must rotate freely in overrunning direction and must not slip in cranking direction. If drive pinion turns roughly or slips, replace the complete drive clutch assembly.

STARTER ASSEMBLY

(Refer to Figure 2)

1. Lubricate splines of armature shaft with engine oil, then insert drive end of armature shaft through shift lever housing until shaft just extends through housing. Place O-ring and collar over armature shaft and position in counterbore in housing. Place brake washer over end of shaft.

2. Position drive clutch assembly in lever housing with lugs on lever yoke engaging groove in drive clutch shift collar, then push armature shaft through housing and drive clutch.

3. Place gasket in counterbore in shift lever housing, then install nose housing over armature shaft and position at lever housing, with marks made prior to disassembly aligned. Attach nose housing to lever housing with six socket head screws; tighten screws to 13-17 foot-pounds torque.

4. Install new O-ring in groove in field frame side of shift lever housing. Install field frame over armature and position against shift lever housing, with marks made prior to disassembly aligned. Attach lever housing to field frame with five cap screws and lock washers. Tighten cap screws firmly.

5. Position solenoid with plunger assembly on field frame, inserting plunger rod end of solenoid into shift lever housing. Through opening in opposide side of lever housing, place plunger rod guide over plunger rod, with trunnions on guide engaging notches in shift lever yoke. Thread adjusting nut a few turns onto plunger rod. Attach solenoid to field frame with four cap screws and lock washers. Install connector strap on solenoid "MOTOR" terminal and field frame terminal stud.

6. Place thrust washer over commutator end of armature shaft. Pull armature out of field frame until part of the commutator extends beyond the field frame. Place new O-ring in groove around commutator end frame. With end frame completely assembled, place brushes over commutator as shown in figure 6, then push the armature into the field frame and position end frame against field frame with marks made prior to disassembly aligned. Attach end frame to field frame with four cap screws and lock washers; tighten firmly.

7. Through openings in field frame, connect field coil leads to brush holders. Install inspection hole covers and gaskets on field frame. Connect

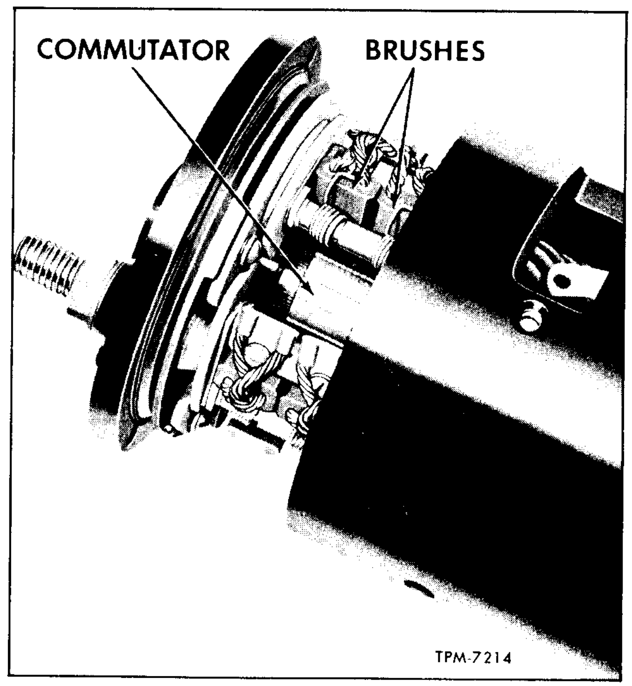


Figure 6—Installing Commutator End Frame

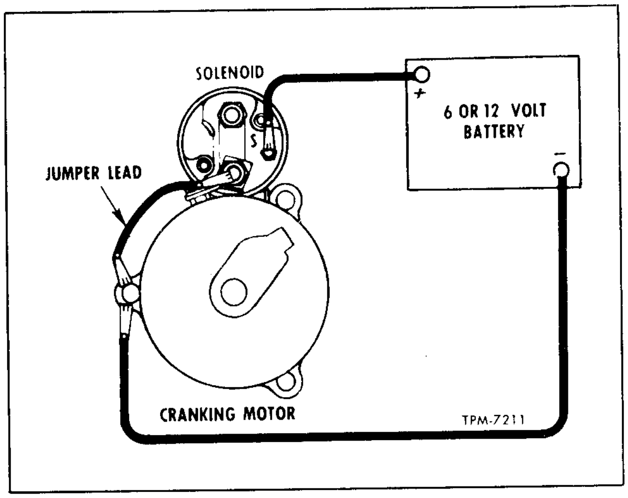


Figure 7—Test Hook-Up For Checking Pinion Clearance

solenoid ground lead to terminal stud on commutator end frame.

8. Adjust pinion clearance as directed below:

Pinion Clearance Adjustment

1. To check the pinion clearance, connect a 6-volt battery from solenoid switch terminal to starter frame (fig. 7). If solenoid does not operate, use a 12-volt battery. To prevent starter from motoring, connect a heavy jumper from solenoid

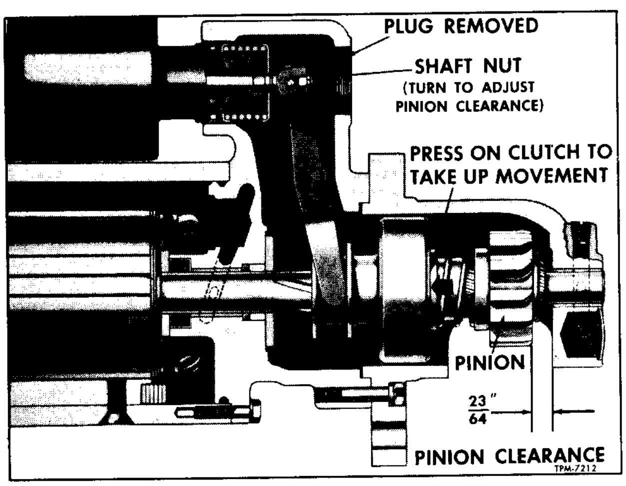


Figure 8—Pinion Clearance Check and Adjustment

ate, use a 12-volt battery. To prevent starter from motoring, connect a heavy jumper from solenoid "MOTOR" terminal to starter frame (fig. 7).

2. With solenoid energized and drive clutch shifted toward the nose housing, push the pinion back toward armature to take up slack, then check clearance between the pinion and nose housing (fig. 8). Adjust nut on solenoid plunger rod as necessary to obtain the proper clearance of 23/64 inch. After correct adjustment is obtained, install access plug and gasket in shift lever housing.

STARTER SOLENOID

Starter solenoid is used to shift the starter drive pinion into engagement with flywheel teeth and to complete the circuit from battery to starter.

Solenoid has two windings, the pull-in winding and the hold-in winding. When starter switch is closed, both windings are energized, producing a magnetic field which pulls the plunger in. Inward movement of plunger shifts starter pinion into engagement with flywheel ring gear teeth, and closes the main contacts in the solenoid switch to complete the circuit from battery to starter.

The pull-in winding draws comparatively heavy current for a short interval. This is required to shift the pinion into engagement. The hold-in winding also aids the pull-in winding. As soon as plunger closes the main switch contact, pull-in winding is de-energized and only the hold-in winding draws current for the balance of the starting cycle.

SOLENOID MAINTENANCE

Solenoid requires no periodic maintenance other than keeping the terminals clean and tight. Always check action of solenoid if it has been removed. If unit fails to function, first check wiring before condemning the solenoid. Solenoid windings can be checked for current draw, open circuit, or shorts. Refer to "Specifications" at end of this section for current values. Solenoid coil, terminals, and switch plunger can be replaced if burned or otherwise damaged. Whenever solenoid is replaced, pinion clearance must be checked and adjusted, if necessary, as previously directed in starter assembly procedures.

SPECIFICATIONS

Make	Delco-Remy
Model Number	1114075
Rotation (viewing drive end)	Clockwise
Min. Brush Tension	35 Oz.
Voltage	12

STARTING SYSTEM SPECIFICATIONS (CONT'D)

No-Load Test	
Volts	11.2
Max. Amps.	165
Min. RPM	7100
Starter Solenoid Model	1119879
Current Consumption @ 80° F.	
Both Windings	
Amperes	78.5-87.8
Volts	12
Hold-in Winding	
Amperes	15.2-17.1
Volts	12
Bushing Diameters (I.D.)	
Commutator End Frame	0.543"-0.545"
Shift Lever Housing	0.810"-0.813"
Nose Housing	0.625"-0.627"

Generator

The generating system consists of an engine-driven, oil-cooled brushless generator, a transistorized voltage regulator, and a starter control and generator relay. Information concerning the transistorized voltage regulator is covered in "REGULATOR" section later in this group. The starter control and generator relay is covered under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section.

IMPORTANT

The electrical system on these coaches is NEGATIVE GROUND. It must be emphasized that if the batteries are not connected for a NEGATIVE GROUND systems, severe damage to the generator, regulator, batteries, and battery cables will result.

GENERAL

The oil-cooled generator (fig. 1) is a self-rectifying AC generator in which all current carrying members, windings, built-in rectifiers, and field coils are stationary. It is a totally enclosed unit, cooled and lubricated by engine oil. The oil inlet is on the rectifier end cover and the oil drains back into the engine crankcase through the drive end frame and gear train cover as shown in figure 2. The generator should never be operated with the oil line disconnected.

Power output is DC with a maximum rating of 220 amperes. It will produce 120 amperes at normal engine idle speed.

The generator has three terminals (fig. 3); the DC power output terminal, a field terminal, and a relay terminal. The relay terminal provides voltage only for the starter control and generator relay. Generating system wiring diagrams are schematically illustrated in figure 4. Refer to "Engine Control and Generator Wiring Diagrams" in back of this manual for complete electrical circuit diagram.

The generator has inherent current regulation so that an external current regulator is not needed. The use of silicon rectifiers eliminates the need for a cut-out relay, since current cannot flow in reverse direction through the rectifiers.

PRECAUTIONS

1. Electrical system is NEGATIVE GROUND. Connecting the batteries with positive ground will result in severe damage to the generator, regulator, batteries, and battery cables.

2. The common trouble-shooting practice of momentarily grounding the generator field terminal to determine presence or absence of field

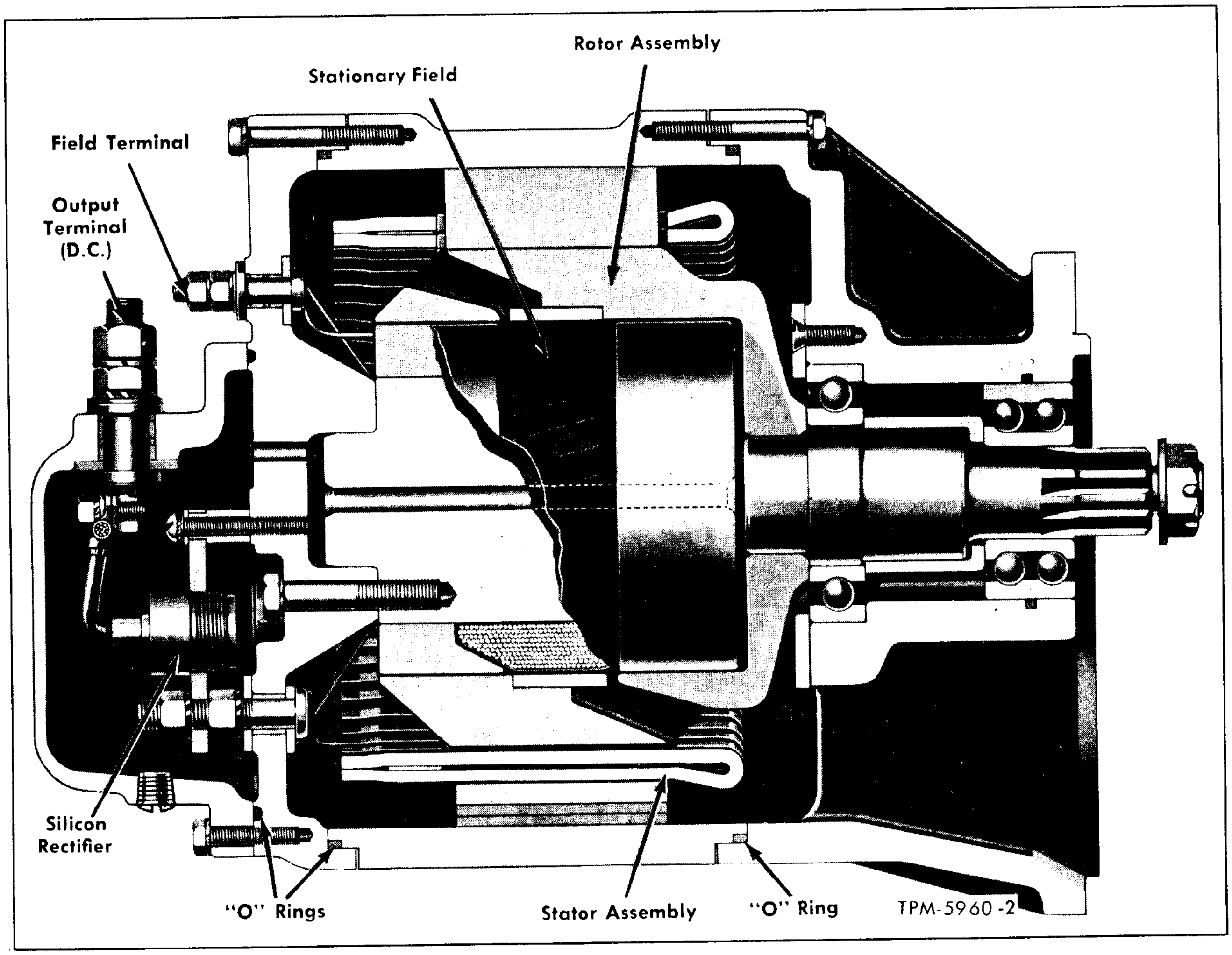


Figure 1—Oil-Cooled Generator

power MUST BE AVOIDED. Grounding the generator field terminal will instantly overload and destroy the transistors within the regulator.

3. The generator output terminal is energized whenever the batteries are connected. If work is to be done near the generator, the batteries should be disconnected to prevent accidental grounding at the generator power output terminal. Disconnect batteries from electrical system by removing cables as explained in "BATTERY" section. Tape cable terminals to prevent accidentally short circuiting when removed.

MAINTENANCE

Because of the absence of brushes, commutator, and rubbing seals, the generator requires no periodic maintenance.

ON-VEHICLE CHECKS

Abnormal operation of the generating system is indicated by a tell-tale in the instrument panel in front of driver. Normally, the tell-tale will light up when "MASTER" switch is placed in either "DAY" or "NITE" position, and will remain on until engine is started and generator is charging. If tell-tale comes on during operation, or if it fails to light when "MASTER" switch is turned on, trouble in the generating system is indicated. The following quick checks will determine if the trouble is in the generator, or starter control and generator relay. If trouble is found not to be in one of these units, refer to "REGULATOR" section later in this group for further checks. Any unit which is found to be defective must be replaced. Internal checks of the generator components can be made as directed later under "Generator Repair."

PRELIMINARY CHECKS

First check the entire generating system for loose connections and broken wires. If generator no-charge tell-tale fails to light when "MASTER"

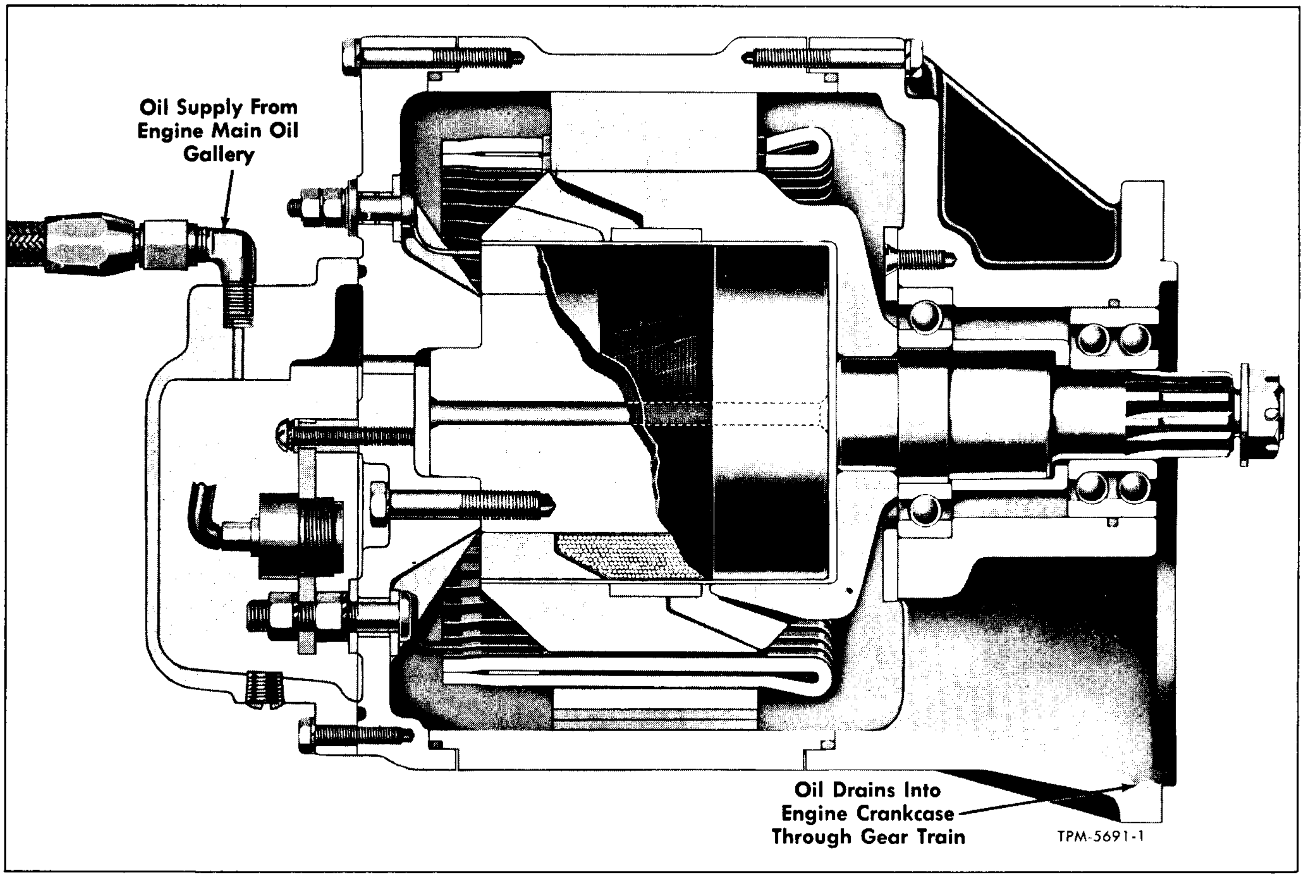


Figure 2—Oil Circulation Through Generator

switch is turned on (before engine is started), make sure tell-tale bulb is not burned out.

GENERATOR

<u>Generator Output Check (See Fig. 5)</u>

1. Disconnect batteries as explained in "BATTERY" section.
2. Disconnect all leads from regulator and lead from generator field terminal.

CAUTION: Do not allow leads to touch ground.

3. Connect a voltmeter and ammeter in circuit as shown.
4. Connect a jumper lead from generator "DC" terminal to generator field terminal as shown.
5. Connect a carbon pile load across battery as shown.

NOTE: Make sure carbon pile is turned off.

6. Reconnect battery as directed in "BATTERY" section.
7. Start engine and operate at approximately 1500 rpm (3100 generator rpm).
8. Turn on all vehicle accessories and adjust carbon pile load until a 220 ampere current draw is shown on ammeter.

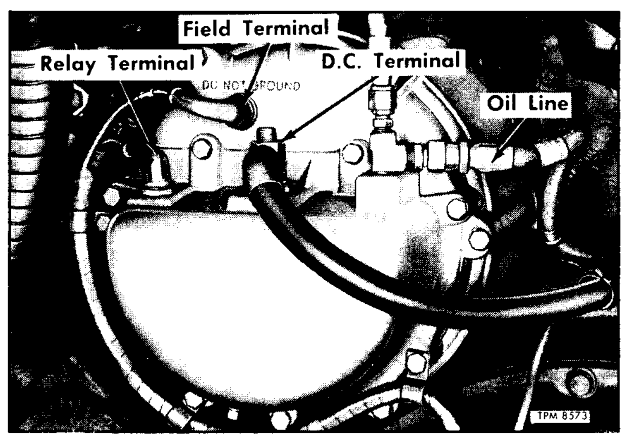


Figure 3—Oil-Cooled Generator Installed

9. Check voltmeter; a minimum voltage reading of 13.7 volts should be obtained.
10. If generator fails to perform as explained in steps 8 and 9, generator is defective. Check component parts of generator as explained under "Troubleshooting."

GENERATOR

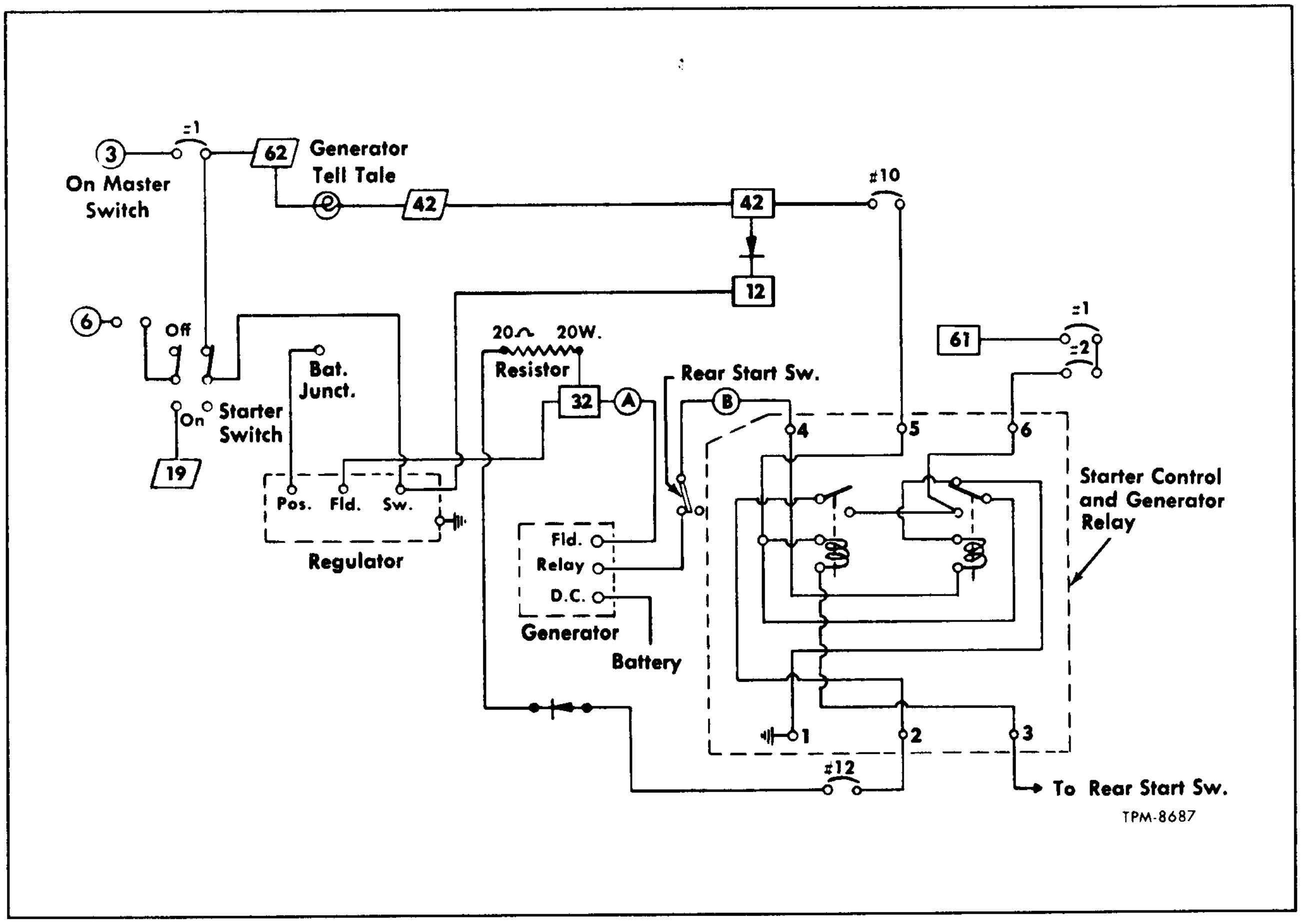


Figure 4—Generator System Schematic Wiring Diagram

Shorted Rectifiers

A shorted rectifier in the output side of the rectifying bridge of the generator will operate the

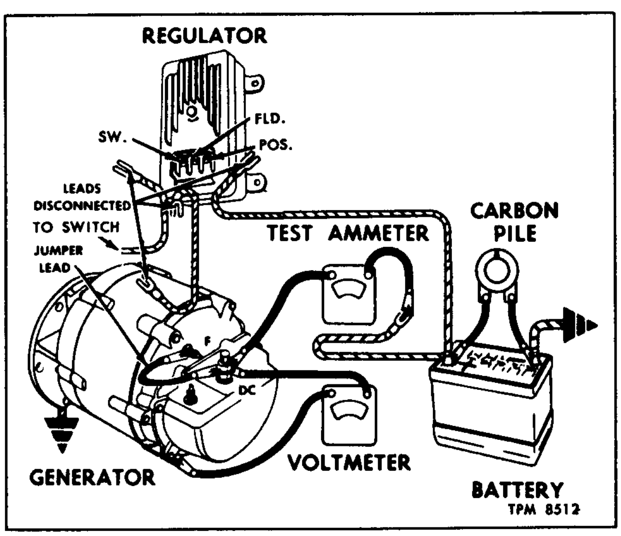


Figure 5—Checking Generator Output

starter control and generator relay interlock. This will be evidenced by:

1. Starter will not operate.
2. The no-charge tell-tale lamp will not light when engine is not running and "MASTER" switch is in "DAY" position.

When the above conditions exist, check rectifiers and replace defective units as directed later under "Generator Repair."

STARTER CONTROL AND GENERATOR RELAY

This unit has a dual function - One relay energizes the starter solenoid; the other relay is powered from the relay terminal of the generator and closes when the generator is charging. The two relays are interconnected so that when the generator is charging the starter relay will not operate if the starter switch is closed.

1. Connect voltmeter leads to No. 4 terminal of relay and to vehicle ground.
2. Start engine. A reading of 6 to 7 volts is normal and indicates proper feed to relay.

3. Connect voltmeter leads to No. 5 terminal of relay and to vehicle ground. Voltmeter should read battery voltage when generator is charging. No voltage indicates a defective relay.

GENERATOR REPLACEMENT

REMOVAL

Refer to figure 6.

1. Remove drain plug from bottom of rectifier end cover and drain oil into a container. Reinstall drain plug after draining.

2. Disconnect wires from "F" and "RELAY" terminals and disconnect battery cable from "DC" terminal on rectifier end cover. Tape end of battery cable to prevent short circuit, and tag wires removed from other terminals for identification at time of installation.

3. Disconnect flexible oil supply line from elbow on rectifier end cover. Remove clip securing flexible oil line to bracket on generator drive end frame.

4. Remove clips securing wiring harness to generator.

5. Remove nuts and lock washers from six mounting studs. Pull generator straight back off mounting studs to complete removal.

6. If a new or rebuilt generator is to be installed, remove driven gear for installation on replacement unit.

INSTALLATION

Key numbers in text refer to figure 6.

1. Before installing generator, inspect drive gear (3) for worn or damaged teeth. If wear or damage is evident, drive gear must be replaced as follows:

a. Remove three socket-head set screws (8) attaching spacer ring (7) to gear train cover. Remove spacer ring and gaskets (13).

b. Remove six socket-head set screws (2) and lock washers attaching internal-toothed drive gear (3) to engine balance shaft gear (1). Remove gear.

c. Position new drive gear (3) on balance shaft gear (1), with pilot on drive gear entering pilot bore in balance shaft gear. Install six socket-head set screws (2) with lock washers and tighten firmly.

d. Place gasket (13) and spacer ring (7) over generator mounting studs (12). Tapered ends of three set screws (9) must enter bore in gear train cover. Attach spacer ring to gear train cover with three socket-head set screws (8). Tighten screws.

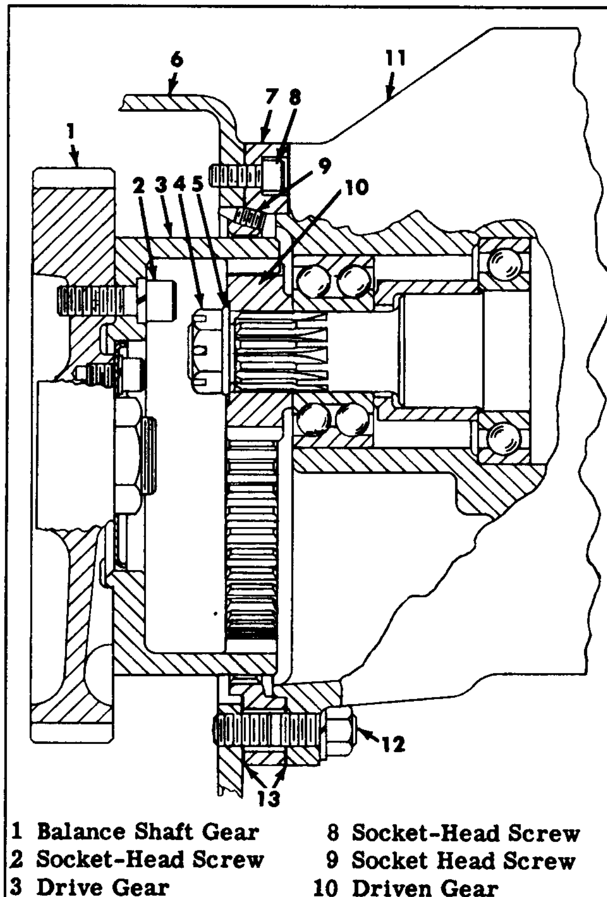
e. Clamp a dial indicator to drive gear (3) in such a manner that indicator pin will contact the generator end frame pilot bore in the spacer ring (7). Turn engine over with starter while observing reading on dial indicator. Pilot bore in spacer ring must be concentric with drive gear within 0.002" total indicator reading. Adjust tapered set screws (9), if necessary, to locate spacer ring within limits. After the proper concentricity is obtained, tighten spacer ring attaching set screws (8) to 8-12 inch-pounds torque.

2. Install drive gear (10) on generator rotor shaft and secure with flat washer (5) and nut (4). Tighten nut to 180 foot-pounds torque and secure with cotter pin.

3. Place gasket (13) over generator mounting studs. Position generator assembly on engine, with holes in end frame flange over mounting studs (12) and with teeth of driven gear engaging teeth in drive gear. Install lock washers and nuts on mounting studs and tighten firmly.

4. Install wiring harness to clips on generator as shown in figure 3.

5. Connect flexible oil line to elbow on rectifier end cover. Secure oil line in clip on bracket attached to generator drive end frame.



1 Balance Shaft Gear	8 Socket-Head Screw
2 Socket-Head Screw	9 Socket Head Screw
3 Drive Gear	10 Driven Gear
4 Gear Retaining Nut	11 Generator End Frame
5 Flat Washer	12 Mounting Stud
6 Gear Train Cover	13 Gaskets
7 Spacer Ring	

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Figure 6—Generator Drive

IMPORTANT: Foreign material may clog the oil inlet orifice in the rectifier end cover. When replacing or connecting oil line, use extreme care to prevent foreign material getting into the oil line or fitting.

6. Connect wires to "F" and "RELAY" terminals and connect battery cable to "DC" terminal. Tighten terminal nuts firmly.

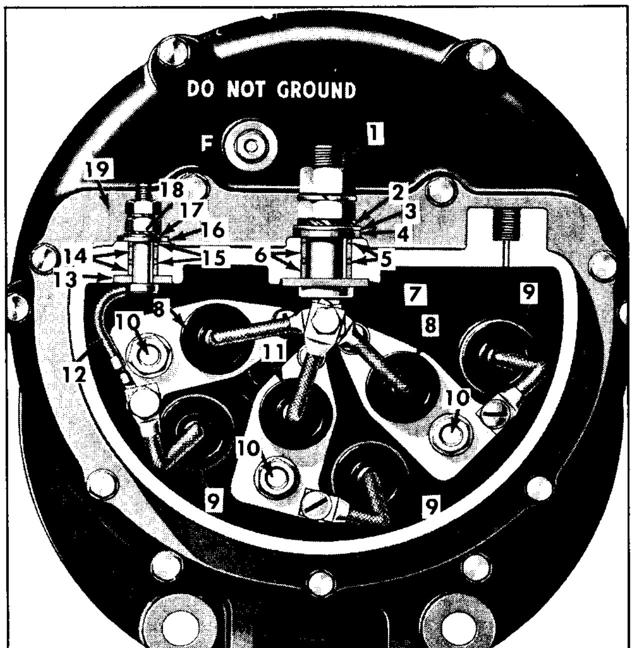
7. Make sure drain plug is installed and securely tightened in rectifier end cover.

TROUBLESHOOTING

GENERAL

It is not necessary to completely disassemble the generator to make electrical checks. All electrical checks are made at the rectifier end of the assembly without disassembling the rotor, drive end frame, and bearings. If electrical components are not defective, but bearing replacement is necessary, this is accomplished at the drive end without disassembling the rectifier end of the unit as explained under "Generator Repair."

These procedures are based on the assumption that "On-Vehicle Checks" have indicated that the generator is malfunctioning and that the generator has been removed from the engine as previously directed under "Generator Replacement."



1 Output Terminal Stud	11 Rectifier & Bracket Assy. (Center)
2 Toothed Lock Washer	12 Relay Terminal Stud & Lead Assy.
3 Flat Washer	13 Insulating Washer
4 Insulating Washer	14 Insulating Sleeves
5 O-rings	15 O-rings
6 Insulating Sleeves	16 Insulating Washer
7 Insulating Washer	17 Flat Washer
8 Rectifier & Bracket Assy. (R.H. & L.H.)	18 Toothed Lock Washer
9 Rectifier Assy. (Three)	19 Rectifier End Cover
10 Stator Terminal Studs	

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Figure 7—Cutaway View Through Rectifier End Cover

RECTIFIER CHECKS

REMOVE RECTIFIER END COVER

In order to remove the rectifier end cover, it is necessary to remove the output terminal stud and relay terminal stud attaching nuts so the studs can be withdrawn from the end cover as the cover is removed from the rectifier end frame.

1. Remove nuts, lock washers, flat washers, and insulating washers from output terminal stud and relay terminal stud (fig. 7). Tap studs lightly, then push studs down into rectifier end cover.

2. Remove seven cap screws and lock washers attaching rectifier end cover to rectifier end frame. Remove end cover from end frame, at the same time completing removal of terminal studs from end cover. Remove O-ring seal from end frame, and remove terminal stud insulating sleeves and O-rings from end cover. Remove insulating washers from terminal studs.

3. Disconnect all rectifier flexible leads, three from output terminal stud and three from rectifier brackets (fig. 8).

NOTE: When checking rectifiers for shorts and opens, use an ohmmeter with a 1-1/2 volt cell. Select a scale on which the 300 ohm value lies within the middle third of the scale.

CHECKING RECTIFIERS FOR SHORTS

If a reading of 300 ohms or less is obtained in either of the checks below, most likely the rectifier being tested is defective. Rectifier should be replaced as explained under "Generator Repair" later in this section.

Rectifier Mounted in Supports

To check rectifiers mounted in supports, connect the positive lead of ohmmeter to each rectifier lead and the negative lead to each support as shown in parts A, B, and C of figure 8. If reading of 300 ohms or less is obtained, replace rectifier.

Rectifier Mounted in End Frame

To check rectifiers mounted in end frame, connect the positive lead of ohmmeter to each rectifier lead and negative lead to end frame as shown in parts D, E, and F of figure 8. If a reading of 300 ohms or less is obtained, replace rectifier.

CHECKING RECTIFIERS FOR OPENS

To check rectifiers for opens, reverse leads of ohmmeter and accomplish procedures given under "Rectifiers Mounted in Supports" and "Rectifiers Mounted in End Frame." An infinite resistance reading indicates an open rectifier.

FIELD WINDING CHECKS

Two methods can be used in checking field windings for opens, grounds and shorts. The preferred method is to check the resistance of field windings, and the alternate method is to check the amperage draw of the field windings.

PREFERRED METHOD

With lead disconnected from "F" terminal, connect an ohmmeter (selected to a 1-1/2 ohm reading at mid-scale) to terminal and rectifier end frame. A resistance reading of 1-1/2 ohms will indicate normal field windings. A resistance reading excessive of 1-1/2 ohms will indicate open field windings. A resistance reading less than 1-1/2 ohms will indicate a shorted or grounded field windings.

NOTE: Due to temperature condition, the resistance reading will vary a fraction of an ohm in some cases.

ALTERNATE METHOD

With rectifier leads disconnected, connect an ammeter and a 12-volt battery in series with the generator field ("F") terminal and ground (on rectifier end frame). Field should pass 8.1 to 8.45 amperes with 12 volts applied.

STATOR WINDING CHECKS

OPENS

To check stator windings for open, connect ohmmeter leads to two pairs of rectifier supports as shown in parts A and B of figure 9. The ohmmeter should show a low resistance. If an infinite or high resistance is obtained in either one or both of the checks, the stator windings are open.

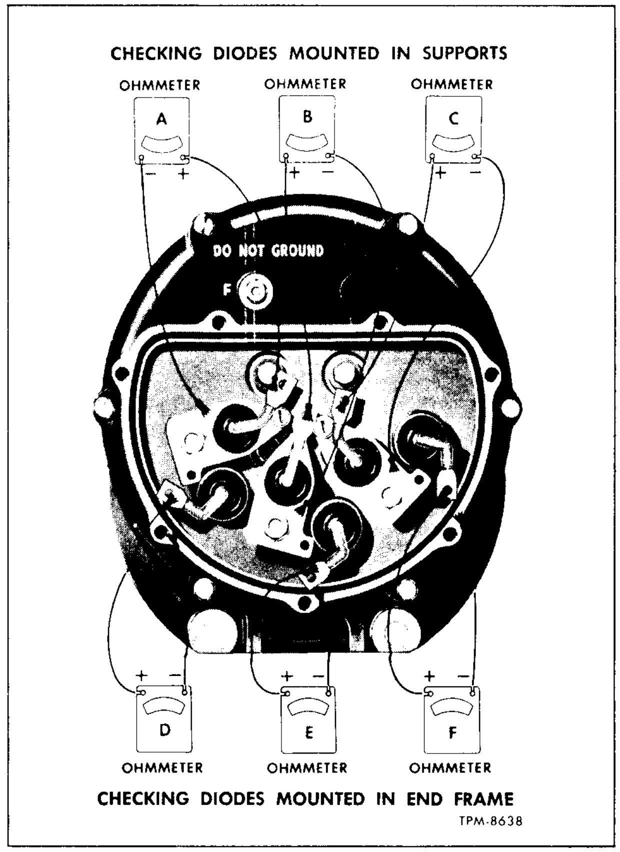


Figure 8—Checking Rectifiers For Shorts

GROUNDS

To check stator windings for grounds, connect an ohmmeter to rectifier support and rectifier end frame as shown in part C of figure 9. The ohmmeter should show an infinite or very high resistance. If a zero or very low resistance reading is obtained, the windings are grounded.

The stator windings are difficult to check for shorts without laboratory test equipment due to the very low resistance of the windings. However, if all other generator checks are satisfactory, yet the generator fails to perform according to specifications, shorted stator windings are indicated.

GENERATOR REPAIR

REPLACEMENT OF ELECTRICAL COMPONENTS

NOTE: The replacement procedures which follow are based on the assumption that the rectifier end cover is still removed and rectifier leads disconnected as required during the preceding tests.

RECTIFIER REPLACEMENT

IMPORTANT: When replacing a rectifier, make sure it is designed for a negative ground system. Rectifier can be identified by the symbol ⚹ stamped on rectifier case. The arrow must point toward the rectifier flexible lead.

The three rectifiers which are mounted in brackets attached to stator lead studs (fig. 7) are serviced only as rectifier and bracket assemblies. The two outer rectifier and bracket assemblies

GENERATOR

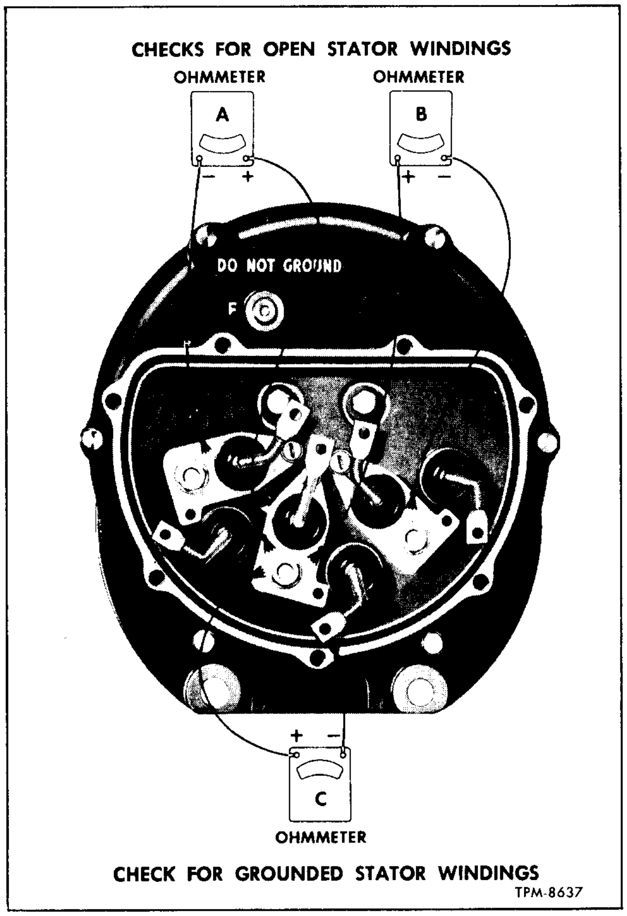


Figure 9—Checking Stator Windings

are identical and can be installed at either side; the center unit has a different bracket, with 2 inches between mounting hole centers (outer brackets have 2-1/4 inch hole centers).

Rectifier and Bracket Replacement

Key numbers in text refer to figure 10. Refer to figure 7 for assembled view.

1. Remove nut w/lock washer (26) attaching rectifier bracket to stator lead stud.
2. Remove screw w/lock washer (30), flat washer (29), and insulating washer (28) attaching bracket to end frame.
3. Remove rectifier and bracket assembly (31 or 32), then remove insulating sleeve (27) from bracket. Also remove insulating sleeve (22) from rectifier lead.
4. Install insulating sleeve (22) over lead of new rectifier and bracket assembly.
5. Place small end of insulating sleeve (27) in hole in pointed end of bracket, then position bracket over stator lead stud. Place flat washer (29) and insulating washer (28) over screw (30), insert screw through insulating sleeve (27) and thread into end frame. Tighten screw firmly. Install nut with lock washer (26) on stator lead stud and tighten firmly.

Rectifier (In End Frame) Replacement

Key numbers in text refer to figure 10. Refer to figure 7 for assembled view.

The three rectifiers (21) which are threaded into the end frame are identical. To remove rectifier, use a thin 1-inch open end wrench on flats of rectifier case to unscrew rectifier from endframe. Coat threads of new rectifier with silicone grease, thread into end frame and tighten to 18-20 foot-pounds torque. Stake rectifier threads on opposite side of lead.

If no other parts are to be replaced, refer to "Rectifier End Cover Installation" later to complete the assembly.

FIELD REPLACEMENT

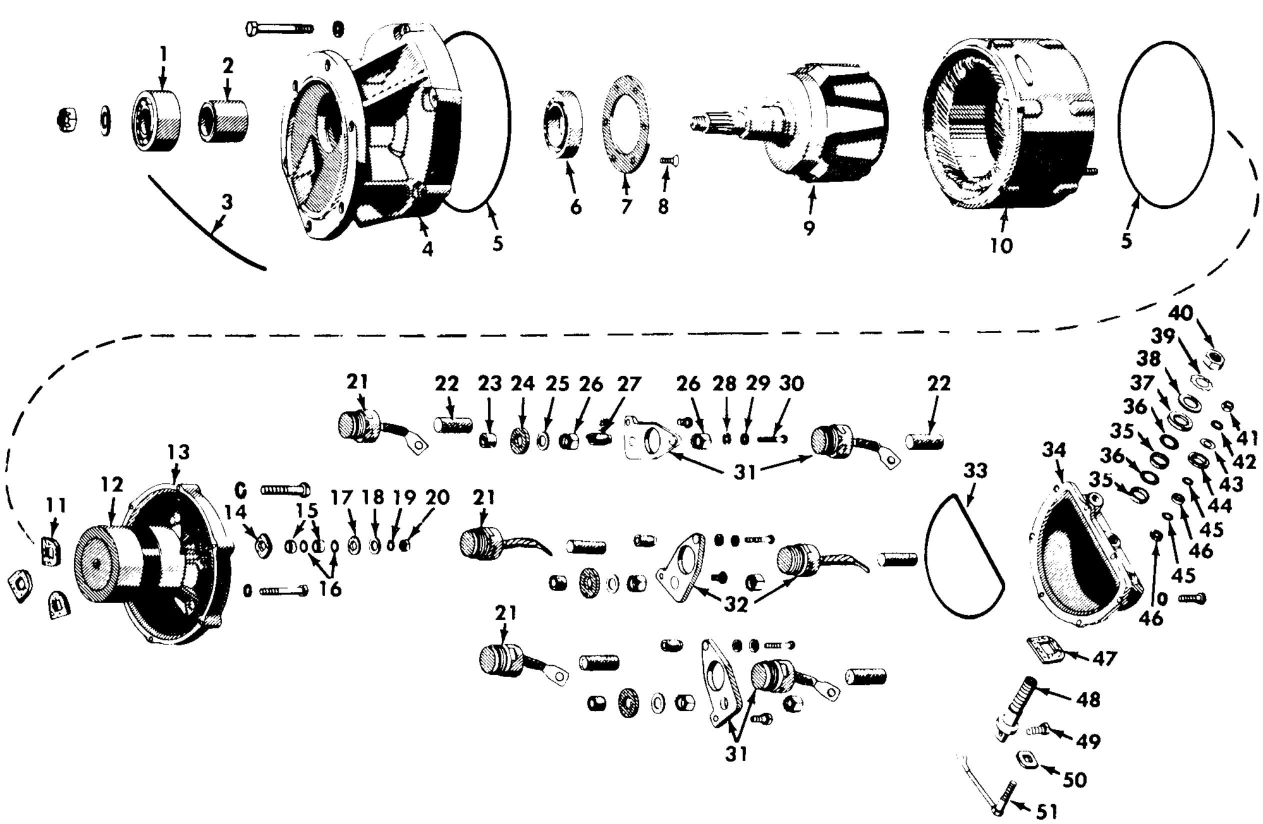
Key numbers in text refer to figure 10.

Removal

1. Remove three rectifier and bracket assemblies (31 and 32) from end frame to provide access to the two lower field to end frame bolts.
2. Remove nut (26), flat washer (25), and insulating washer (24) from three stator lead studs.
3. Remove six bolts and lock washers attaching rectifier end frame to stator frame.
4. Separate end frame from stator frame and withdraw end frame and field assembly from rotor, at the same time pushing stator lead studs out of end frame.
5. Remove nut (20), lock washer (19), flat washer (18), and insulating washer (17) securing field lead terminal stud in end frame. Push stud out of end frame.
6. Remove four bolts and lock washers attaching field to end frame.
7. To separate field from end frame install four 3/8-24 x 3" bolts in place of the 3/8-24 x 2" attaching bolts removed in step 6. Thread bolts in to equal heights. Support end frame in arbor press, and using a suitable press plate to exert force on all four bolt heads, press field out of end frame.

Installation

1. Position field assembly at end frame, insert four 3/8-24 x 3" bolts through end frame, and thread into field to keep holes aligned.
2. Support end frame on arbor press bed in such a manner that the rectifiers will not be damaged and press field into end frame. Press in until shoulder on field core bottoms against end frame.
3. Remove the four guide bolts. Install four 3/8-24 x 2" bolts, using new lock washers, attaching field to end frame and tighten securely.
4. Place square insulating washer (14) over field terminal stud and insert stud through hole in



1 Double Row Ball Bearing
2 Bearing Spacer
3 Bearing Clamp
4 Drive End Frame
5 O-ring Seal
6 Single Row Ball Bearing
7 Bearing Retainer Plate
8 Retainer Plate Screw
9 Rotor and Shaft Assy.
10 Stator and Frame Assy.
11 Insulating Washer
12 Field Assy.
13 Rectifier End Frame
14 Insulating Washer
15 Insulating Sleeves
16 O-rings
17 Insulating Washer
18 Flat Washer
19 Toothed Lock Washer
20 Nut
21 Rectifier (in end frame)
22 Rectifier Lead Insulating Sleeve
23 Insulating Sleeve
24 Insulating Washer
25 Flat Washer
26 Nut w/Lock Washer
27 Insulating Sleeve
28 Insulating Washer
29 Flat Washer
30 Rectifier Bracket Attaching Screw
31 Rectifier w/Bracket Assy. (R.H. & L.H.)
32 Rectifier w/Bracket Assy. (Center)
33 O-ring Seal
34 Rectifier End Cover
35 Insulating Sleeves
36 O-rings
37 Insulating Washer
38 Flat Washer
39 Toothed Lock Washer
40 Output Terminal Stud Nut
41 Relay Terminal Stud Nut
42 Toothed Lock Washer
43 Flat Washer
44 Insulating Washer
45 O-rings
46 Insulating Sleeves
47 Insulating Washer
48 Output Terminal Stud
49 Cap Screw
50 Insulating Washer
51 Relay Terminal Stud and Lead Assy.

TPM-6898

Figure 10—Generator Components

end frame. Place an insulating sleeve (15), an O-ring (16), another insulating sleeve (15), and another O-ring (16) over field terminal stud and push these parts into end frame. Make sure square insulating washer (14) is in place at inner side of end frame, then install insulating washer (17), flat washer (18), toothed lock washer (19), and nut (20) on terminal stud and tighten firmly.

5. Install each of three stator lead studs in end frame as follows: Place insulating washer (11) over stud and insert stud through end frame. Place insulating sleeve (23) over stud and position in hole

in end frame. Install insulating washer (24), flat washer (25), and nut with lock washer (26) on stud and tighten firmly.

6. Install three rectifier and bracket assemblies on end frame as previously directed under "Rectifier Replacement."

7. Install new O-ring seal (5) in notch around end of stator frame. Insert field into rotor and position end frame against stator frame. Attach end frame to stator frame with six bolts and lock washers. Tighten bolts firmly.

8. If no other parts require replacement, refer to "Rectifier End Cover Installation" later to complete the assembly.

STATOR REPLACEMENT

Key numbers in text refer to figure 10.

If tests indicated an open circuit or short in the stator, the stator and frame assembly must be replaced.

Removal

1. Remove rectifier end frame and field frame assembly as previously directed in steps 1 thru 4 under "Removal" in "Field Replacement" procedure

2. Remove six bolts and lock washers attaching stator frame to drive end frame.

3. Separate stator frame from drive end frame and remove from end frame and rotor.

Installation

1. Position new O-ring seal (5) in notch around drive end of stator frame.

2. Position stator and frame assembly over rotor against drive end frame. Attach stator frame to drive end frame with six bolts and lock washers. Tighten bolts firmly.

3. Install rectifier end frame and field assembly as directed in steps 5, 6, and 7 under "Installation" in "Field Replacement" procedure.

4. Install rectifier end cover as directed later.

RECTIFIER END COVER INSTALLATION

Key numbers in text refer to figure 7 unless otherwise indicated.

1. Make sure all rectifiers are properly installed and securely tightened. Leads from rectifiers threaded into end frame must be securely attached to rectifier brackets. Relay terminal lead must also be attached to left rectifier bracket as shown in figure 7.

2. Connect leads from three rectifiers mounted in brackets to output terminal stud (1) as shown in figure 7. Tighten attaching screw firmly. Place insulating washer (7) over output terminal stud (1), and place insulating washer (13) over relay terminal stud (12).

3. Place new O-ring seal (33, fig. 10) in groove in rectifier end frame.

4. As rectifier cover is positioned at end frame, the output terminal stud and relay terminal stud must be inserted through holes in top of end cover. Wrapping soft wire around stud threads and inserting wires through the holes will facilitate pulling studs through holes. Make sure insulating washers are on terminal studs.

5. With end cover in place against end frame, install seven attaching cap screws and lock washers. Tighten cap screws firmly.

6. Referring to figure 7, install insulating sleeves and O-rings over output terminal stud and relay terminal stud, and position in cover between studs and holes in cover. Make sure insulating washers are in place in counterbores on underside of cover. Secure each terminal stud in place with insulating washer, flat washer, toothed lock washer, and nut. Tighten nuts firmly.

7. Make sure drain plug is installed and securely tightened in bottom of end cover. Plug oil inlet opening in top of cover to keep out dirt until generator is installed.

BEARING OR ROTOR REPLACEMENT

Whenever the rotor and drive end frame are disassembled for any reason, the single row ball bearing must be replaced with a new one due to the probability of its being damaged during disassembly.

REMOVAL AND DISASSEMBLY

Key numbers in text refer to figure 10.

1. If driven gear was not removed from rotor shaft at time of generator removal, remove nut and flat washer from shaft and pull gear off shaft.

2. Remove six bolts and lock washers attaching drive end frame to stator frame. Separate drive end frame from stator frame and remove drive end frame and rotor assembly.

3. Support drive end frame in arbor press in such a manner that the rotor can be pressed down out of end frame. Using a suitable adapter against end of rotor shaft which will pass through the inner race of the double-row ball bearing, press rotor down out of end frame and bearings.

4. Remove six screws (8) attaching bearing retainer plate (7) to drive end frame. Remove retainer plate.

5. Support drive end frame in arbor press, with double-row bearing up, in such a manner that the bearings can be pressed down out of end frame. Using a suitable driver which will exert force on both the inner and outer races of the double-row bearing, press bearings downward out of end frame. (The bearing spacer (2) transmits force from the double-row bearing inner race to the inner race of the single-row bearing; since this force is transmitted to the single-row bearing

outer race through the balls, the bearing is likely to be damaged and must be replaced with a new part.)

6. Remove rubber bearing clamp (3) from groove in end frame bearing bore.

ASSEMBLY AND INSTALLATION

Key numbers in text refer to figure 10.

1. Press new single-row ball bearing into inner side of drive end frame. Install bearing retainer plate (7) and attach with six screws (8). Stake screws in place after tightening.

2. Position rubber bearing clamp (3) in groove in bearing bore in drive end frame. Lubricate clamp to permit bearing to be pressed in without dislodging or damaging the clamp.

3. Position rotor in arbor press with shaft end up. Install drive end frame and single-row bearing assembly over rotor shaft. Using a driver over rotor shaft which will exert force on the bearing inner race, press bearing onto shaft until it bottoms against the rotor.

4. Install bearing spacer (2) over rotor shaft. Position double-row bearing (1) over rotor shaft at end frame bore. Using an adapter which will exert force on both the inner and outer races of the bearing, press bearing onto shaft and into end frame until inner race bottoms against bearing spacer.

5. Place new O-ring seal (5) in notch around drive end of stator frame.

6. Insert the rotor between the stator and field, and position drive end frame against stator frame. Attach end frame to stator frame with six bolts and lock washers. Tighten bolts firmly.

SPECIFICATIONS

Make	Delco-Remy
Model Number	1117670
Rotation	Either
Field Current @ 80° F.	
Amperes	8.1-8.45
Volts	12
Hot Output	
Amperes	220
Volts	14
Approximate RPM	3100

Regulator

CAUTION: This regulator is to be used on vehicles having a negative ground electrical system only.

GENERAL

The transistor regulator used on all vehicles covered by this manual is an assembly composed principally of diodes, condensers, resistors, and transistors. These components are mounted on a printed circuit panel board to form a completely static unit containing no moving parts. Regulator terminal connections are marked "SW," "FLD," and "POS."

The regulator components work together to limit the generator voltage to a pre-set value by controlling the generator field current. This is the only function the regulator performs in the charging circuit.

The voltage at which the generator operates is determined by the regulator adjustment. Once adjusted, the regulator voltage remains constant, since the regulator is unaffected by length of service, changes in temperature, or changes in generator output and speed.

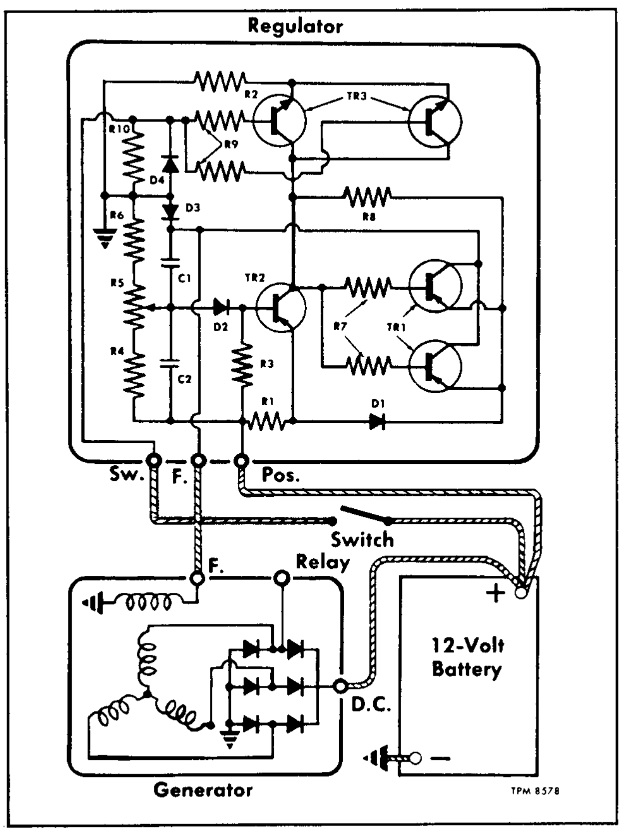
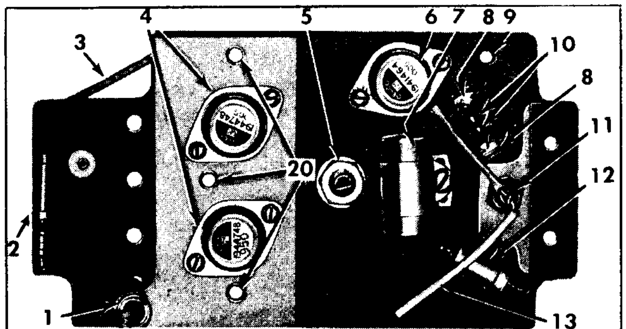


Figure 1—Regulator Circuitry Diagram

Figure 1 shows regulator circuitry with each major component identified. Figure 2 shows corresponding items in actual location on panel board in respect to circuitry diagram (fig. 1).

ON VEHICLE ADJUSTMENT

Trouble in the electrical system will usually be indicated by one of two conditions - an under-



1 Field Discharge Diode (D3)
2 By-Pass Resistor (R10)
3 Wire Wound Resistor (R2)
4 Power (Output) Transistors (TR1)
5 Potentiometer (R5)
6 Driver Transistor (TR2)
7 Feed-Back Condenser (C1)
8 Field Shut-off Transistor (TR3)
9 Zener Diode (D2)
10 Base Resistors (R9)
11 Back-Bias Diode (D1)
12 Filter Condenser (C2)
13 Feed-Back Resistor (R1)
14 Wire Wound Resistor (R4)
15 Wire Wound Resistor (R3)
16 Wire Wound Resistor (R8)
17 Wire Wound Resistor (C7)
18 Suppressor Diode (D4)
19 Wire Wound Resistor (R6)
20 Insulators

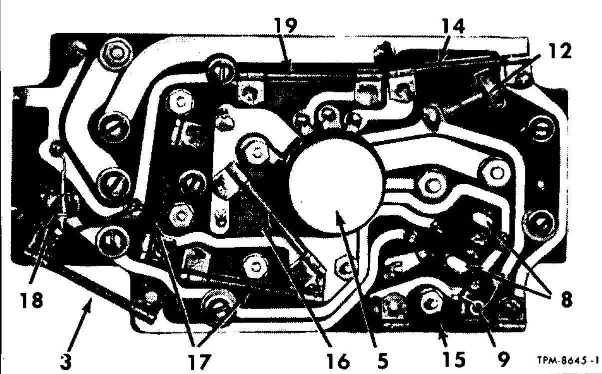


Figure 2—Regulator Components

charged battery or an overcharged battery. Either condition can result from an improper voltage regulator setting.

The ideal voltage setting is the one which will maintain the batteries in a fully charged condition with a minimum use of water. Check and adjust voltage regulator setting as follows:

NOTE: Refer to figure 3 for voltmeter connection.

1. Connect a voltmeter from regulator "POS" terminal to ground.

2. Start engine and operate at approximately 1000 rpm (about 2300 generator rpm).

3. Turn on vehicle blower motor.

4. Observe voltmeter; a steady reading of 13.7 volts should appear. If this reading is not present, remove plug from regulator and adjust potentiometer (fig. 4) until reading is obtained.

NOTE: In some cases, when maximum special electrical equipment is used and an undercharged battery condition results over a period of time, it may be necessary to adjust regulator to 14-volts. If this is the case, operate vehicle a minimum service period of 48 hours and check for an improved battery condition. The same procedure applies for an overcharged battery, except adjust voltage to 13.4 volts.

5. If voltage cannot be adjusted by turning potentiometer, and it is evident that trouble exists in generating system, check generator as directed in "GENERATOR" section of this manual. If generator is found to be satisfactory, check regulator as directed under "Troubleshooting" in this section.

REGULATOR REPLACEMENT

Voltage regulator is located in battery compartment at left side of vehicle. On some early production vehicles, regulator is located in baggage compartment at left side of vehicle. To replace regulator refer to figure 5 and accomplish following steps:

REMOVAL

1. Determine if regulator is located in baggage compartment or battery compartment and gain access to regulator.

2. Disconnect three leads from regulator "SW," "FLD" and "POS" terminals and mark leads for installation reference.

CAUTION: Do not allow "POS" terminal lead to become grounded against vehicle body. Tape lead to prevent accidentally grounding.

3. Remove four attaching nuts and pull regulator from mounting studs.

INSTALLATION

1. Position regulator on studs, with terminal board upward.

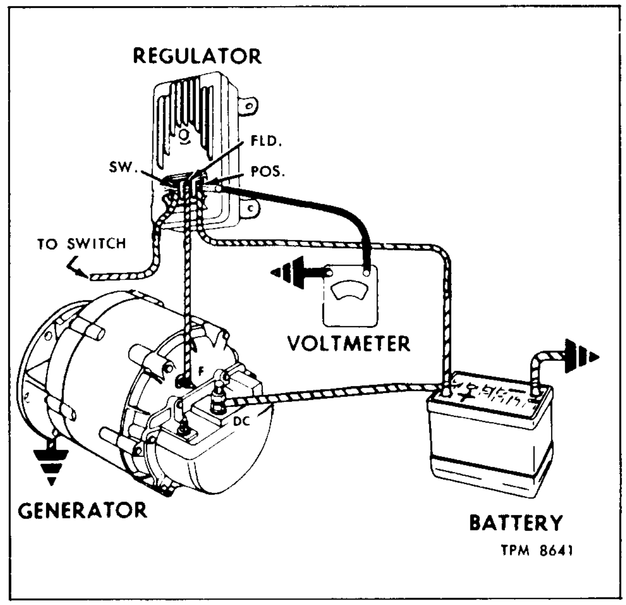


Figure 3—Checking Regulator Voltage Setting

2. Install four washers and nuts.

3. Install "SW," "FLD" and "POS" terminals to terminal board, referring to identification marks made prior to removal.

TROUBLESHOOTING

Various electrical checks with an ohmmeter can be made to determine which components are defective. The component parts are identified in figure 2. The ohmmeter must be accurate, and must be one which uses a 1-1/2 volt dry cell.

When making checks, note carefully in the illustrations how the ohmmeter is connected with regards to polarity, and select a scale applicable to check being made.

It is important that the following checks be made in the order listed. If a defective part is

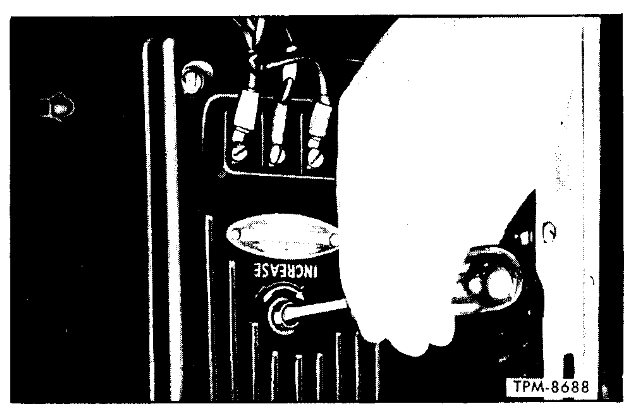


Figure 4—Adjusting Regulator Voltage

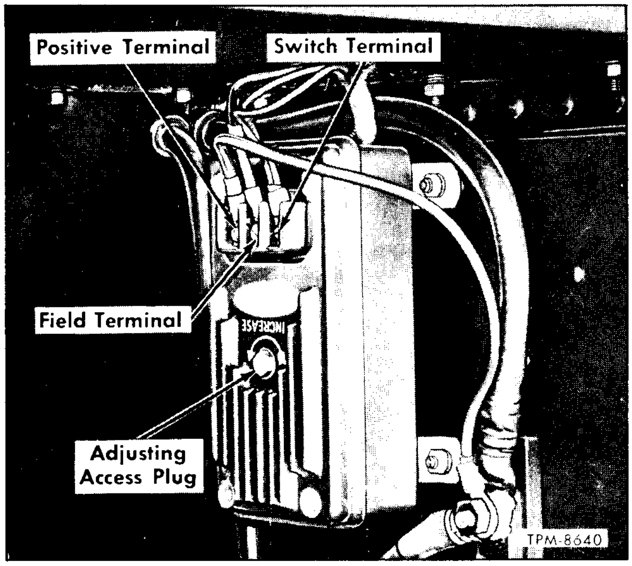


Figure 5—Regulator Installed (Late Models)

found, replace it before proceeding with the remaining checks. Be sure to make all the checks as more than one component may be defective.

A defective part may be replaced by removing any attaching screws involved and/or unsoldering the connections. To replace the parts identified in figure 2 separate the printed circuit board from the cover by removing the eight attaching screws shown in figure 2. When resoldering, limit solder time to a minimum as excessive heat may damage the printed circuit and component parts. However, good soldered connections are essential for satisfactory operation. A rosin core 63% tin 37% lead solder with 360°F. melting point is recommended, along with a soldering iron rated at 50 watts or less. Use extreme care to avoid overheating.

ZENER DIODE

To check the Zener diode (9, fig. 2), unsolder the connection and lift the lead up just enough to separate the lead from the printed circuit. Bending the lead too far may cause it to break off inside the diode. Then connect the ohmmeter

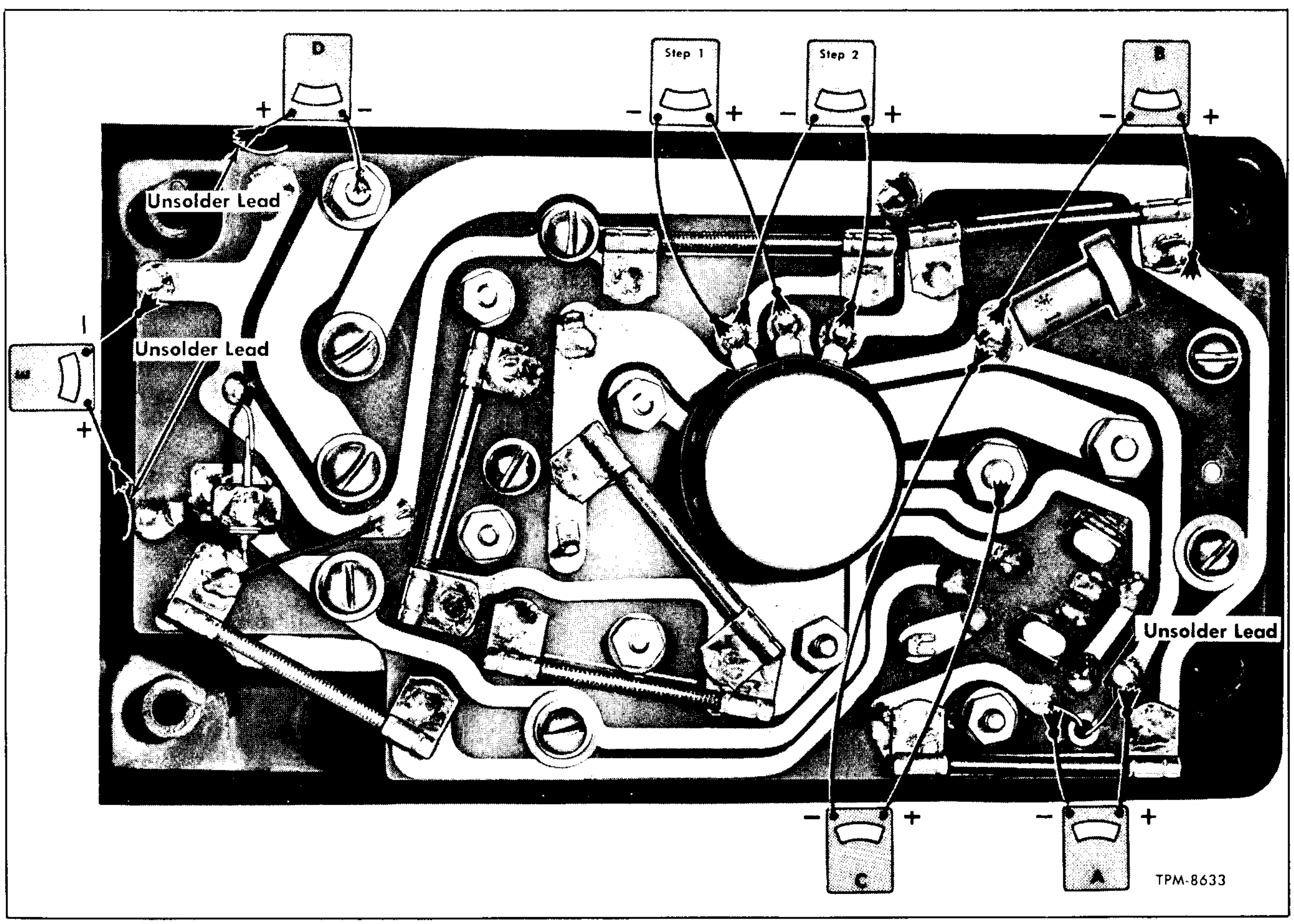


Figure 6—Regulator Component Checks

leads as shown in Part "A" of figure 6. If the reading is zero, the diode is shorted. If the reading is very high (infinite) the diode is open. Resolder the diode lead before proceeding.

POTENTIOMETER

To check the potentiometer (5, fig. 2), connect ohmmeter leads as shown in Steps 1 and 2 of figure 6. If either reading is 100 ohms or above, potentiometer is open.

FILTER CONDENSER

To check the filter condenser (12, fig. 2) connect ohmmeter leads as shown in part "B" of figure 6. A zero ohm reading indicates a shorted filter condenser. To check for opens, inspect the two soldered connections for breaks.

FEED-BACK CONDENSER

To check the feed-back condenser (2, fig. 2) connect ohmmeter leads as shown in part "C" of figure 6. If a zero ohm reading is obtained, condenser is shorted. To check for opens, inspect the soldered connection.

FIELD DISCHARGE DIODE

To check field discharge diode (1, fig. 2), unsolder lead and connect ohmmeter leads as shown in part "D" of figure 6. If a zero ohm reading is obtained, diode is shorted. If a very high (infinite) reading is obtained, diode is open.

NOTE: Before proceeding with other check, resolder diode lead.

BY-PASS RESISTOR

To check the by-pass resistor (2, fig. 2), unsolder resistor lead and connect ohmmeter as shown in part "E" of figure 6. If reading is over 200 ohms, resistor is defective.

NOTE: Before proceeding with other checks, resolder resistor lead.

BACK BIAS DIODE

To check the back bias diode (11, fig. 2), connect ohmmeter leads as shown in part "A" of figure 7. A zero ohm reading indicates a shorted diode, and a reading over 100 ohms indicates an open diode.

SUPPRESSION DIODE

To check the suppression diode (18, fig. 2), unsolder lead and connect ohmmeter leads as shown in part "B" of figure 7. A zero ohm reading indi-

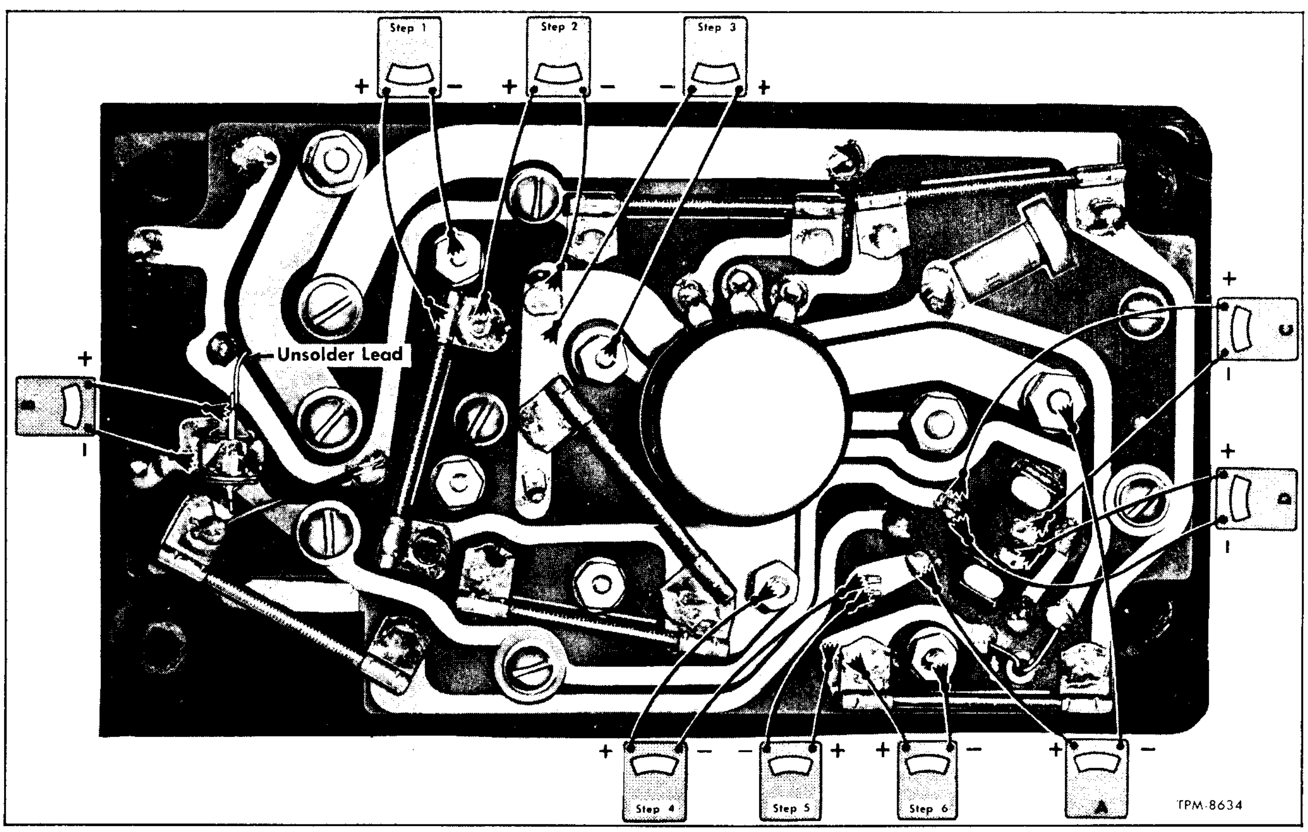


Figure 7—Regulator Component Checks

REGULATOR

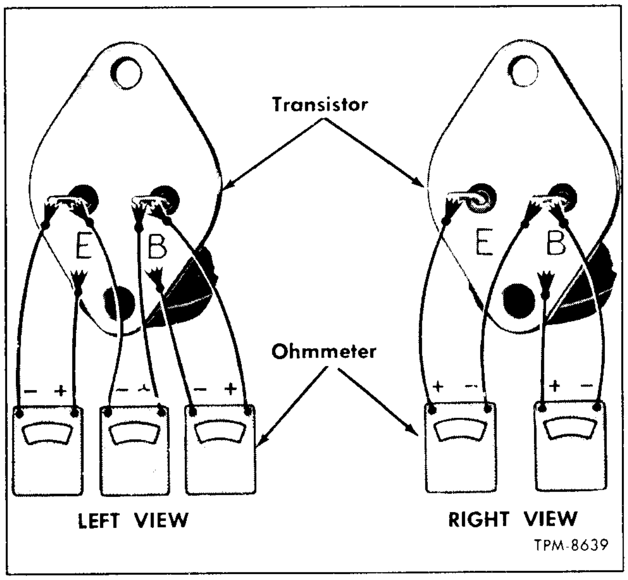


Figure 8—Checking Transistors Removed From Panel Board

cates a shorted diode and a very high (infinite) reading indicates an open diode.

NOTE: Before proceeding with other checks, resolder diode lead.

POWER TRANSISTORS

Shorted Transistor

Check the power transistors (4, fig. 2), by connecting the ohmmeter the three ways shown in Steps 1, 2, and 3 of figure 7. If any reading is zero ohms, one of the power transistors is shorted. To determine which power transistor is shorted, or if both transistors are shorted, remove the upper

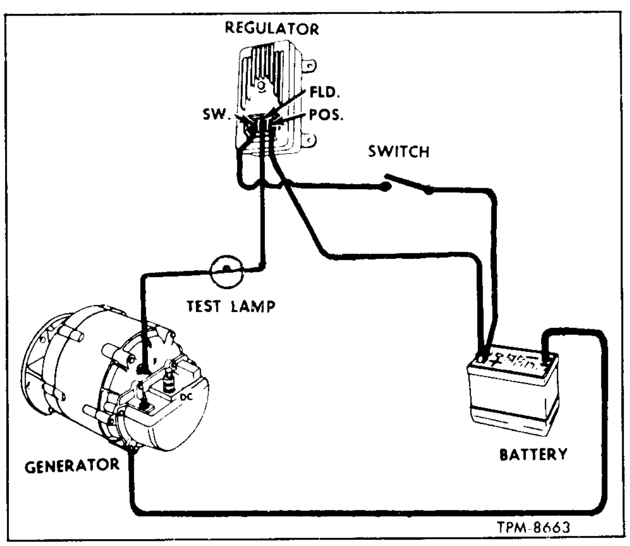


Figure 9—Bench Test Connections For Checking Field Shut-Off Transistors

transistor (4, fig. 2) and repeat the check as shown in figure 7 on the transistor which is still mounted on the printed circuit board. If any of the three readings is zero, the transistor is shorted. Also check the transistor which has been removed by connecting the ohmmeter the three ways shown in left view of figure 8. A zero reading in any one of the three checks indicates a shorted transistor.

Open Transistor

Check power transistors for opens by removing transistor from panel board and connecting ohmmeter to each transistor as shown in right view of figure 8. A very high (infinite) reading in either check indicates an open transistor.

DRIVER TRANSISTOR

Shorted Transistor

Check the driver transistor (6, fig. 2), by connecting ohmmeter as shown in steps 4, 5, and 6 of figure 7. The transistor being checked is shorted if a zero ohm reading is obtained.

Open Transistor

Check the driver transistors for opens as explained under "Power Transistors."

BASE RESISTORS

Check the base resistors (10, fig. 2) by connecting ohmmeter the two ways shown in Parts "C" and "D" in figure 7. A reading above 200 ohms indicates the resistor being checked is defective.

FIELD SHUT-OFF TRANSISTORS

To check the field shut-off transistors (8, fig. 2), make connections to the regulator as shown in figure 9, and also connect a test lamp in the circuit at the "F" terminal on the generator. With the switch open, the test lamp should not light. If the test lamp lights with the switch open, at least one of the field shut-off transistors is shorted. In this case, replace both of the field shut-off transistors, as the other is most likely defective.

CAUTION: When replacing field shut-off transistors, note relative location of transistor leads so the new transistors can be installed with correct lead connections.

If the test lamp does not light when switch is closed, and all other regulator components check satisfactorily as described above, both field shut-off transistors are open and must be replaced.

NOTE: When attaching the panel board to the cover, note carefully the location of insulators as shown in figure 2. Also, visually re-check all soldered connections and wire-wound resistors for opens.

REGULATOR SPECIFICATIONS

Make	Delco-Remy
Type	Transistorized
Model Number	9000559
Polarity	Negative
Quantity of Transistors	
Power (Output)	2
Driver	1
Field Shut-off	2
Voltage Setting	13.7 (See text)

Lighting System

GENERAL

Circuits for all lights used for regular illumination purposes are shown on "Coach Lighting Wiring Diagram" (MD-89119). Circuits for stop light and directional signals are shown on "Stop and Directional Lamp Wiring Diagram"(MD-88755). Circuits for tell-tale lights are shown on "Alarm and Signal Wiring Diagram" (MD-88616).

IMPORTANT: All lights should be checked daily and necessary replacements made. Bulb sizes are listed in "Specifications" at end of this section. A spare headlight package assembly, fog light bulb, stop light or directional light bulb, and tail, license, Michigan identification or marker light bulb are carried in a carton in safety compartment.

SWITCHES AND CIRCUIT BREAKERS

All interior and exterior lights required for normal operation of the vehicle are controlled by the "MASTER" switch on control panel at left of driver. Light circuits which are energized when "MASTER" switch is in "OFF," "DAY," "NITE," or "PARK" position are listed below under "Master Switch."

Reading and general lights are controlled by a secondary switch located on driver's control panel. Switch positions are marked "GEN'L" and "NORM." When switch is placed in "NORM" position, current is supplied to switches for reading lamps and to illuminate general lamps.

Engine compartment, baggage compartment spot, lavatory, front step, ventilation compartment, aisle seat, air conditioning condenser compartment and refrigerant receiver tank lights are controlled by secondary switches operated by door or manually.

All lighting circuits are protected by automatic reset type circuit breakers. Location and rating of all the circuit breakers are covered in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

"MASTER" SWITCH

Master switch circuit positions are marked "OFF," "DAY," "NITE," and "PARK." Selected circuits become energized when circuit caption on switch is rotated into alignment with position indicator button on control panel. Only the lighting circuits controlled by the various switch positions are listed below. Refer to "Master Switch Operation" in "WIRING AND MISCELLANEOUS ELECTRICAL" for listing of all circuits controlled by the master switch.

"OFF" Position
1. Stop and diectional light controls
2. Baggage compartment light controls
3. Engine compartment light controls
4. General light controls
5. Ventilation compartment light controls

"DAY" Position
1. All lights listed under "OFF" position
2. Lavatory light controls
3. Tell-tale light circuits

"NITE" Position
1. All lights listed under "OFF" and "DAY" position
2. Instrument lights
3. Tail lights
4. Aisle seat lights
5. License plate lights
6. Corner marker lights
7. Identification lights
8. Nite lights
9. Lounge seat light

"NITE" Position (Cont'd.)
10. Destination sign lights
11. Side clearance lights
12. Spot light
13. Entrance door lights
14. Refrigerant tank light
15. Head and fog lights
16. Reading lights

"PARK" Position
Same as 1 through 14 of "NITE" position

EXTERIOR LIGHTING EQUIPMENT

HEADLIGHTS

Each headlight consists of two 5-3/4-inch Type T-3 sealed-beam lamp units. Outer lights are double-filament units, having upper and lower beams. Inner lights are single-filament units, and are used only in conjunction with the upper beam of the outer units. The inner units are identified as Type 1 and have the numeral "1" molded in top of lens; the outer units are Type 2, with the numeral "2" molded in top of lens.

Type T-3 sealed-beam unit lens incorporate three projecting guide points which are optically ground to provide flat surfaces at right-angles to the light beam (fig. 1). This design permits adjustment of the light beams in daylight without the use of an aiming screen and without requiring a large work area. Aiming is accomplished with a "T-3 Safety Aimer, Type B" (J-6663). Instructions for using the T-3 aimers are supplied by the instrument manufacturer. Headlights can also be adjusted without the use of the mechanical aimer as follows:

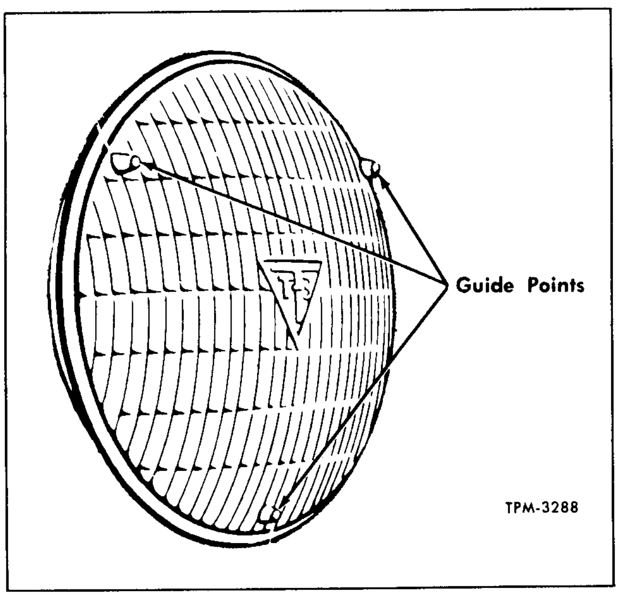


Figure 1—T-3 Headlight Lens

AIMING PROCEDURE

Inner (High-Beam) Lights (Fig. 2)

1. Position vehicle on level floor with headlights 25 feet from a smooth vertical surface. Surface should be provided with paper or a panel which can be removed to permit drawing two sets of aiming lines. Centerline of vehicle must be at right-angle to the vertical surface.
2. Measure height of headlight centers from floor and mark this height on vertical surface. Draw a horizontal line A-A on vertical surface at this height. Draw a second horizontal line B-B parallel with and 2 inches below line A-A.
3. Locate point at which projected centerline of vehicle intersects these lines and draw a vertical line C-C.
4. Measure distance between centers of inner lights, then divide this distance equally on both sides of centerline C-C. Draw a vertical line (D-D and E-E) through each of these points.
5. Remove headlight trim ring for access to adjusting screws. Turn "MASTER" switch to "NITE" position and select high beam with dimmer switch. Cover all lights except one inner light.
6. The high intensity zone of the beam pattern should center at the point where vertical line (D-D or E-E) intersects horizontal line B-B. Turn vertical adjusting screw (fig. 3) to raise or lower the beam pattern, and turn horizontal adjusting screw to move it to right or left.
7. After completing adjustment on one inner light, cover that light, uncover other inner light, remove trim ring and adjust in the same manner.
8. Remove paper or panel from vertical surface to permit drawing aiming lines for outer lights. NOTE: Lines A-A and C-C in figure 2 are in same location for figure 4 and can be located on vertical surface in same place by taking measurements from the removed paper or panel.

Outer (Low Beam) Lights (Fig. 4)

1. Locate projected centerline of vehicle and

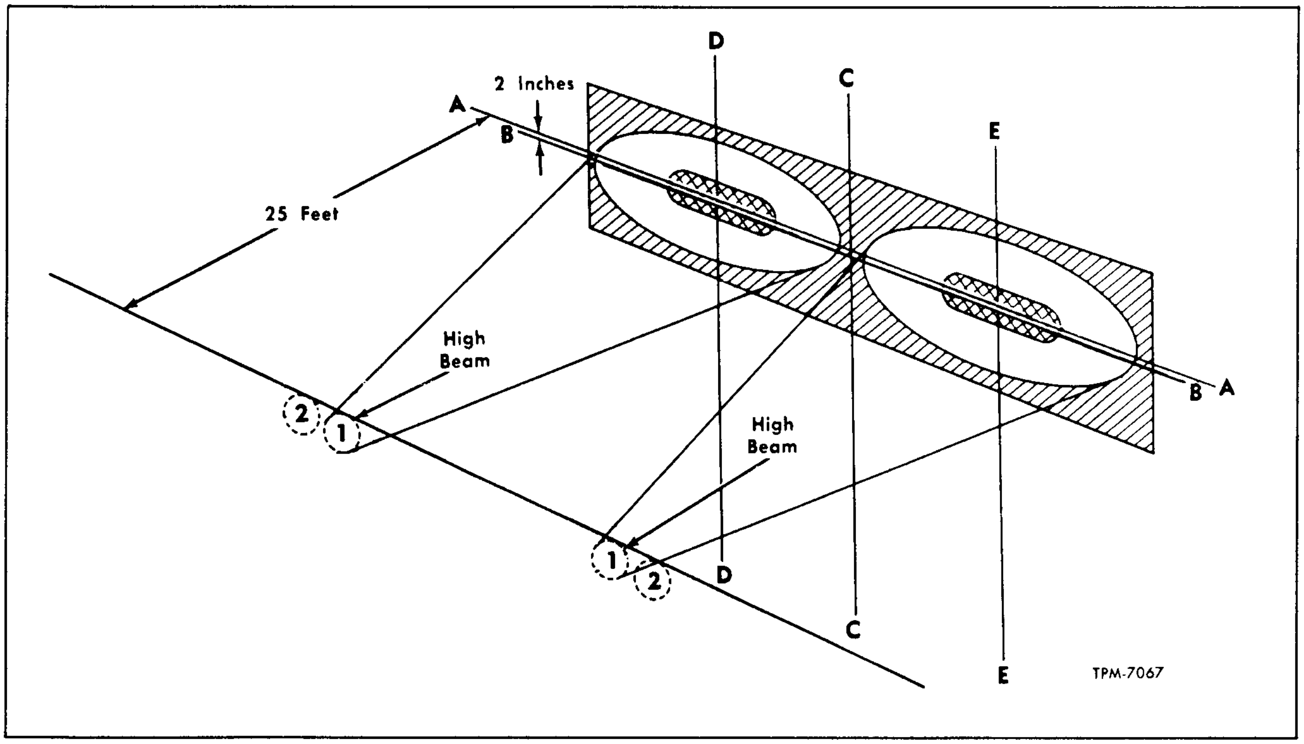


Figure 2—Inner Light (High Beam) Aiming Chart

height of headlight centers in same manner as in steps 2 and 3 under "Inner Lights," except that horizontal line B-B is omitted.

2. Measure distance between centers of outer lights and divide this distance equally on both sides of centerline C-C. Draw a vertical line (D-D and E-E) through each of these points.

3. Turn "MASTER" switch to "NITE" position and select low beam with dimmer switch (inner lights will not be illuminated). Cover one light while adjusting the other. The edge of the intensity zone of the beam pattern must be just below the horizontal centerline (A-A) and to the right of the vertical centerline (D-D or E-E). Turn vertical or horizontal adjusting screws as necessary to obtain this condition.

4. After all lights are properly adjusted, install headlight trim rings.

SEALED-BEAM UNIT REPLACEMENT

Removal

1. Remove screw attaching trim ring and remove ring.

2. Remove two screws attaching sealed-beam unit retaining ring to mounting ring.

3. Unhook spring from retaining ring and remove retaining ring.

4. Remove sealed-beam unit and pull wiring connector plug off back of unit.

Installation

NOTE: Sealed-beam unit with number "1" molded in top of lens must be used at inside lights. Unit with number "2" on lesn must be used at outside lights.

1. Install wiring connector plug on back of sealed-beam unit. Position unit in mounting ring with lugs on back of unit engaging holes in mounting ring. Molded number on lens must be at top.

2. Position retaining ring over lens and secure to mounting ring with two screws.

3. Hook spring into hole in retaining ring.

NOTE: If headlight beam was properly adjusted before sealed-beam unit replacement, it is not

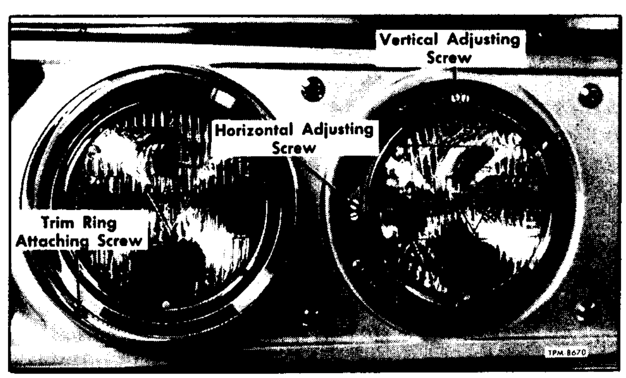


Figure 3—Headlight Adjusting Screws

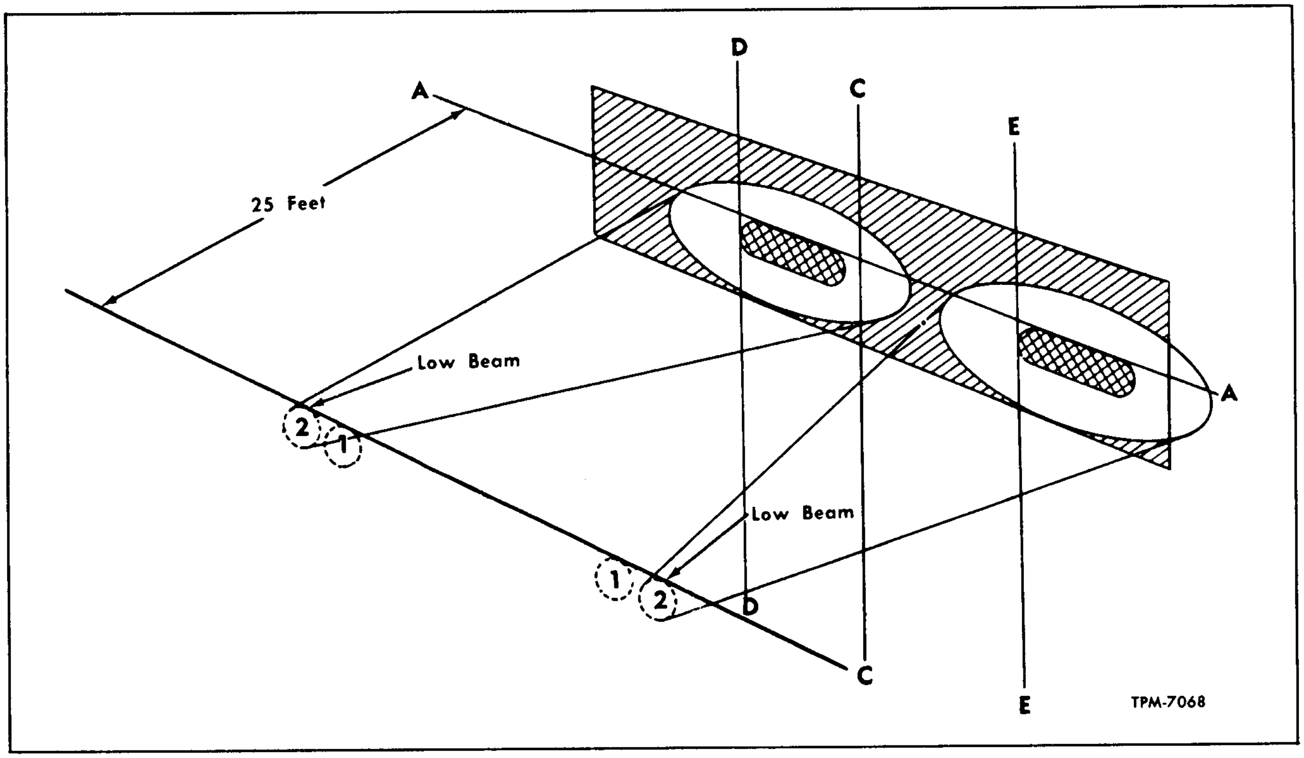


Figure 4—Outer Light (Low Beam) Aiming Chart

necessary to adjust beam, providing adjusting screws were not removed. If adjusting screws were moved, adjust headlight beam as previously directed under "Aiming Procedure."

4. Install trim ring and attaching screw.

HEADLIGHT DIMMER SWITCH, AND HEAD AND FOG LIGHT SELECTOR SWITCH

Foot-operated switches located on floorboard near clutch pedal are used to select either the headlight or fog light circuit, and to select either headlight upper or lower beam when headlights are being used. These switches are operative only when "MASTER" switch is placed in "NITE" position. Rearward foot-operated switch is the headlight dimmer switch. Forward foot-operated switch is the head and fog light selector switch.

Switches require no maintenance; however, switch may be replaced by removing mounting screws, after which switch is readily accessible from under floor through tool compartment.

When installing foot-operated switch, connect wires to terminals before attaching switch to floor boards. IMPORTANT: Correct wire must be connected to switch terminal marked "BAT" as follows: Dimmer switch - black with red check; selector switch - black with two green parallel tracers. Connect other two wires to remaining terminals; position of these wires with respect to terminals is not important.

STOP, DIRECTIONAL, AND EMERGENCY FLASHER LIGHTS

The stop, directional and emergency flasher systems, use the same lights. Lights are located on front and rear of coach on both left and right sides. Flasher units for the directional and emergency flasher systems are protected by number 21 circuit breaker located in driver's control panel junction box. Stop light system is protected by number 4 circuit breaker located in electrical control junction box.

STOP LIGHT SYSTEM

Stop light system consists of two lights, an air operated switch mounted on top of rear brake relay valve, stop light tell-tale relay mounted in electrical compartment junction box and stop light tell-tale light located on driver's gauge and tell-tale panel. Stop light circuit is shown on "Stop and Directional Light Wiring Diagram."

Operation

When brakes are applied and stop lamp switch is closed, current is supplied to left and right stop lights through stop light tell-tale relay, emergency flasher switch and directional signal switch. When stop light tell-tale relay is energized, current is supplied to illuminate stop light tell-tale light.

Tell-tale light is illuminated at all times when brakes are applied and stop light switch is closed.

Stop lights flashes on and off when emergency flasher circuit is placed in operation. When directional signal switch is placed in left or right turn position, stop light for that particular side flashes on and off.

Bulb Replacement

Bulb socket is molded into a rubber base which fits into the lamp housing in same manner as a rubber grommet (fig. 5). Open engine compartment door for access to back of lamp housing. Grasp bulb socket base and pull out of lamp housing. DO NOT PULL ON WIRES. Remove bulb from socket and install new bulb. Install bulb socket base in lamp housing, pushing base into opening with a twisting motion until inner lip of base slides over the inner edge of the opening. It may be necessary to use a silicone lubricant on inner lip to facilitate installation.

Switch Removal

Remove shield from top of switch. Disconnect wires from switch terminals, then unscrew switch from pipe nipple in top of relay valve.

Switch Repair (Fig. 6)

Disassemble switch and examine diaphragm and contact points. Replace diaphragm if cracked or damaged. If contact points are only slightly burned or pitted, they may be reconditioned using a contact point file. If points are badly damaged, terminal screw and contact plunger with new points should be installed. Replace spring if weakened by rust or corrosion. Make sure vent hole in cover is open.

Switch Installation

Thread switch onto pipe nipple in top of relay valve and tighten firmly. Connect wires to switch terminals, then install shield over switch. With air pressure in system, apply brakes and check operation of stop lights.

Stop Light Tell-Tale Relay

Operation, maintenance, and adjustment of stop light tell-tale relay are described under "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

DIRECTIONAL SIGNAL SYSTEM

Directional signal system consists of two lights, located on engine compartment door at rear of coach; two lights on front of coach, and on some coaches two front side lights. Directional signal lights at rear of coach are also used as stop lights. Directional signal system is controlled by directional signal switch located on steering column and flasher unit located in driver's control panel junction box. Directional signal circuit is shown on "Stop and Directional Light Wiring Diagram."

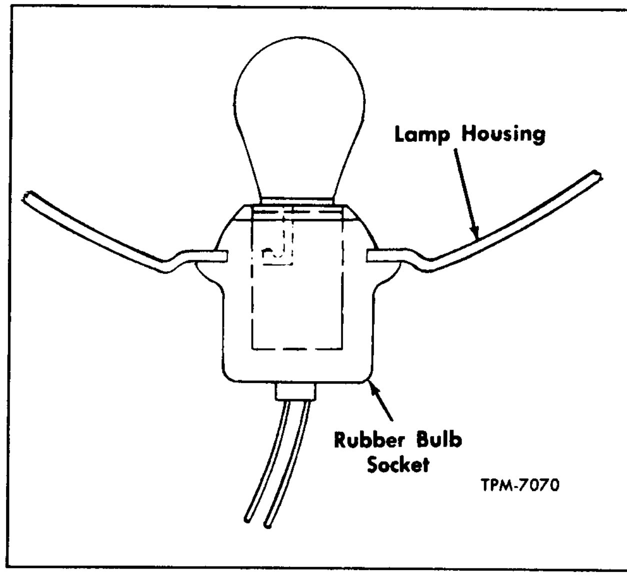


Figure 5—Bulb Socket—Typical For Rear Stop and Directional Lights, Taillights and Front Directional Lights

Operation

When directional signal switch is placed in up or down position (left or right turn), circuit is completed from flasher unit "L" terminal through switch to front and rear directional lights. Direc-

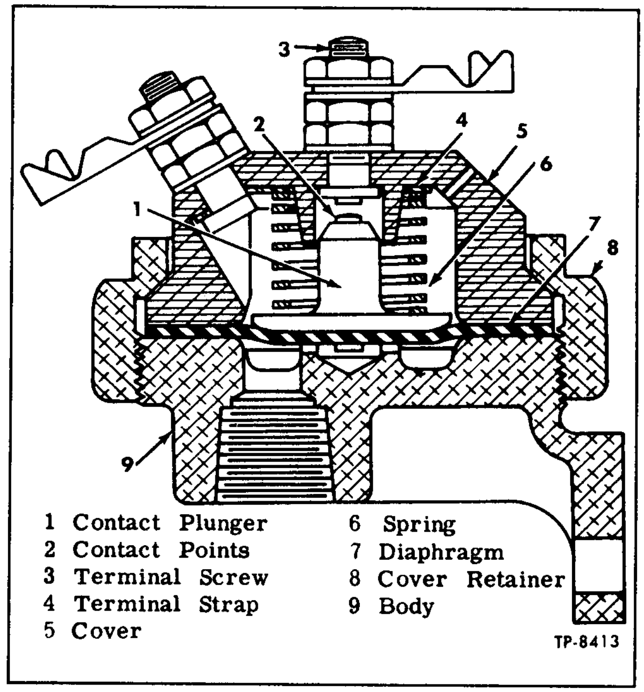


Figure 6—Stop Light Switch

tional signal circuit overrules stop light and emergency flasher signal light on side which directional signal was selected.

Switch

Directional signal lights are controlled by a self-cancelling switch mounted on steering column below steering wheel at left side. Pushing switch lever up (forward) turns on right front and rear directional signals, and pulling lever down (rearward) turns on left front and rear directional signals. When turn is completed, switch lever automatically returns to off position. Electrical connections from control panel junctions to switch are made through an Amphenol connector mounted below the gauge and tell-tale panel.

Directional Light Bulb Replacement

Rear directional light bulbs are the same bulbs used as stop lights; replacement is previously described under "Stop Lights." Front directional light bulbs are replaced in same manner. Left front light is accessible from inside the coach in driver's compartment; right front light is accessible through the dash compartment door. Side directional light bulbs (above front wheelhousings, when used) are accessible after removing two screws attaching lens to lamp and removing lens.

EMERGENCY FLASHER SYSTEM

Emergency flasher system consists of two stop lights at rear of coach, two directional signal lights at front of coach, and on some coaches, two side directional signal lights. System is operated by emergency flasher switch located on dash panel and flashing cycle is controlled by flasher unit mounted in driver's control panel junction box. Emergency flasher system circuit is shown on "Stop and Directional Light Wiring Diagram."

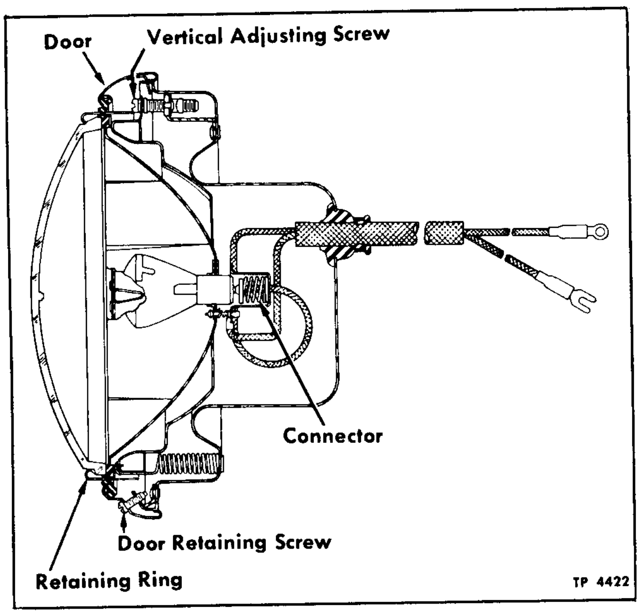


Figure 7—Fog Light

Operation

When emergency flasher switch is placed in "EMERG. FLASHER" position, circuit is completed from "L" terminal of flasher unit through switch to stop lights and directional signal lights. Lights flash at a steady cycle until switch is placed in "OFF" position. If directional signal switch is accidentally placed in left or right turn position, the front light(s) for side being selected will become inoperative. Rear (stop) light will continue flashing using directional signal circuit. Directional signal tell-tale light operates when emergency flasher system is operative.

Switch

Emergency flasher switch is a double-pole single-throw lever type switch, and is secured to dash panel with a hex-head nut. To remove switch, remove nut and decal, pull switch from under dash and disconnect four wires.

IMPORTANT: Make sure wires are clearly identified before removing from switch to insure proper position when installing switch.

FOG LIGHTS

Fog lights (fig. 7) are mounted at lower front corners of coach directly below headlights and behind outer ends of front bumper. Holes are provided in bumper at fog lights. A bulb with a metal fog cap to prevent glare from direct rays, and an amber lens are the identifying characteristics of this type of light.

Fog light circuit is energized by foot-operated selector switch after "MASTER" switch on driver's control panel is placed in "NITE" position. Either the headlights or fog lights are on when "MASTER" switch is in "NITE" position, never both at the same time.

Fog Light Bulb Replacement (Fig. 7)

1. Remove two spare tire compartment door special lug bolts located in bumper opening between fog light openings. Swing bumper and spare tire compartment door downward.
2. Remove fog light door retaining screw, then remove door.
3. Remove three retaining ring screws, then remove retaining ring and lens.
4. Press in on bulb, at same time turning bulb counterclockwise to remove bulb.
5. Position new bulb in light with prongs engaged in holes in bulb flange. Due to prong spacing bulb can be installed in only one position.

6. Press bulb in firmly, turning bulb clockwise at the same time. Make sure all prongs are properly engaged.

7. Install lens, retaining ring, and three retaining ring screws.

8. Install door, engaging clip on door in slot at top of light body. Fasten door with screw.

9. Swing bumper and tire compartment door up into position and secure with two lug bolts.

FOG LIGHT ADJUSTMENT

Refer to "Aiming Procedure" under "Headlights" previously in this section. Fog lights are adjusted in same manner as headlights; however, beam pattern differs from headlight pattern. Fog light "Hot Spot" is more concentrated around center line of light and "cut-off" at top of beam is more sharply defined than on headlights. Swing bumper and tire compartment door downward as directed in step 1 under "Fog Light Bulb Replacement" for access to fog lights.

TAILLIGHTS

Taillights are mounted in engine compartment door below stop and directional signal lights. Tail light circuit is energized with "MASTER" switch in "NITE" or "PARK" position. Taillight circuit, together with all marker lights, identification lights, door step lights, and instrument panel lights, is protected by number 13 circuit breaker in control panel junction box at left of driver. Taillight circuits and connections are shown on "Coach Lighting Wiring Diagram."

BULB REPLACEMENT

Taillight bulbs are accessible and replaceable in same manner previously described under "Stop Lights."

CORNER MARKER LIGHTS

A marker light is mounted at each corner of coach near top. Marker light circuits are energized with "MASTER" switch in "NITE" or "PARK" position. Circuit is protected by number 13 circuit breaker in driver's control panel junction box at left of driver. Light bulbs are accessible for replacement after removing lens. Each lens is attached to body with two screws.

IDENTIFICATION LIGHTS (MICHIGAN MARKER)

Six identification lights (Michigan Marker) are mounted - three at rear of coach above window and three at front of coach above destination sign. Light circuits are energized when "MASTER" switch is placed in "NITE" or "PARK" position. Circuit is protected by number 13 circuit breaker in driver's control panel junction box at left of driver. Rear light bulbs are accessible for replacement after removing lens. Each lens is attached to body with two screws. Front light bulbs are accessible by lowering front destination sign door.

FRONT DESTINATION SIGN LIGHTS

Four front destination sign lights, mounted behind destination sign curtain, provide illumination for destination sign. Lights are controlled by "MASTER" switch on driver's control panel and are protected by number 13 circuit breaker in driver's control panel junction box. When "MASTER" switch is placed in "NITE" or "PARK" position, sign is illuminated. Refer to "Coach Lighting Wiring Diagram" for electrical circukt. Bulbs are accessible for replacement from inside coach after lowering sign and door, then lifting top curtain roller from bearing at right side.

SIDE DESTINATION SIGN LIGHTS

Two side destination sign lights, mounted behind destination sign curtain on right side of coach, provide illumination for side destination sign used as special equipment on some coaches. Lights are controlled by "MASTER" switch and are protected by number 13 circuit breaker in driver's control panel junction box. When "MASTER" switch is placed in "NITE" or "PARK" position, sign is illuminated. Refer to "Coach Lighting Wiring Diagram" for electrical circuit. Replacement of light bulbs is as follows:

BULB REPLACEMENT

Removal

1. From inside coach, remove screws attaching forward-right heating and cooling duct. Remove duct away from sign box.

2. Remove screws attaching lower portion of sign box.

3. Slide portion of sign box downward until bulb access is gained.

4. Remove defective bulb(s) from socket, by pushing inward and turning counterclockwise.

Installation

1. Replace defective bulb(s) by placing new bulb in socket, pushing inward and turning clockwise.

2. Place bottom portion of sign box in proper position and install attaching screws.

3. Install heating and cooling duct.

LICENSE PLATE LIGHTS

Two license plate lights, mounted directly above license plate, are used to illuminate license

plate. Lights are operative when "MASTER" switch is placed in either "NITE" or "PARK" position. Lights are protected by number 13 circuit breaker in driver's control panel junction box. Electrical circuit for lights is shown in "Coach Lighting Wiring Diagram." To replace defective bulb, remove two screw attaching mounting bracket, pull bracket and lamp assembly out enough to remove lens from lamp body.

SPOT LIGHT

The spot light is mounted through front corner post at left of windshield. Beam is directed by handle from inside of coach. Light is operative when "MASTER" switch is placed in "NITE" or "PARK" position and switch on handle is in on position. Spot light circuit is protected by number 14 circuit breaker in driver's control panel junction box and is shown on "Coach Lighting Wiring Diagram." Spot light is equipped with a Sealed-Beam unit.

To replace Sealed-Beam unit, remove screw attaching spot light ornament to top of light body and remove ornament; then remove retainer ring and lens which are attached to light body with screw. Remove Sealed-Beam unit from light body and disconnect wires from back of unit. Install new Sealed-Beam unit by reversing the above procedure.

INTERIOR LIGHTING EQUIPMENT

INSTRUMENT PANEL LIGHTS

Gauges on instrument panel in front of driver are illuminated when "MASTER" switch is placed in "NITE" or "PARK" position. Instrument panel lights are protected by number 13 circuit breaker in driver's control panel junction box. Electrical circuit for lights is shown on "Coach Lighting Wiring Diagram."

Light bulbs are accessible by pulling bulb socket free from back of panel. Bulb can then be removed from socket. After replacing bulb, press socket firmly into back of panel housing.

STEPWELL LIGHTS

Entrance door stepwell is illuminated by light mounted on body inside front panel. Light circuit, protected by number 14 circuit breaker in driver's control panel junction box, is illuminated when "MASTER" switch is placed in "NITE" or "PARK" position and entrance door is open. The entrance door control mechanism switch is located under dash panel at right of driver. Control mechanism is illustrated in BODY (SEC. 3). Circuits for stepwell light is shown on "Coach Lighting Wiring Diagram."

To replace bulb, remove lens and retainer which are secured to light body with two screws.

GENERAL (DOME) LIGHTS

General interior lights are mounted on package rack edge, and are controlled by switch on driver's control panel. With switch in "GEN'L" position, circuit through general lighting magnetic switch is electrical compartment is energized; or with switch in "NORM" position and "MASTER" switch in "PARK" position, magnetic switch is energized. These circuits are protected by number 23 and 7 circuit breakers in driver's control panel junction box. Magnetic switch points then close and complete circuits to lights. Magnetic switch-to-light circuits are protected by circuit breakers in electrical compartment; number 16 circuit breaker protects right side light circuit, and number 15 circuit breaker protects left side light circuit. Refer to "Coach Lighting Wiring Diagram." Bulbs are accessible after removing package rack edge cover which is secured to edge with screws. Screws are located on package side of package rack edge cover.

READING LIGHTS

Reading lights are mounted on underside of package racks. Before lights can be turned on by individual light switches, the "MASTER" switch must be in "NITE" position and interior lighting switch in "NORM" position. When "MASTER" switch is placed in "NITE" position and interior lighting switch is in "NORM" position, circuit is completed to energize reading lamp magnetic switch in electrical compartment junction box. When magnetic switch points close, current is directed to individual light switches. Circuit to energize magnetic switch is protected by number 17 circuit breaker in driver's control panel junction box. Protective devices for left and right side reading lights are circuit breakers number 13 and 14 in electrical compartment junction box. Reading light circuits are shown on "Coach Lighting Wiring Diagram." Each light has two bulbs and two switches, except rear lounge light which has only one bulb and switch. To replace bulb in light assembly, remove two screws attaching lens and retainer.

DRIVER'S LIGHT

Driver's light, mounted on trim panel above driver's window, is controlled by "MASTER" switch and "DRIVER'S LIGHT" switch on driver's control panel. Before light can be operated by

"DRIVER LIGHT" switch, "MASTER" switch must be in "NITE" or "PARK" position. Driver's light circuit is protected by number 14 circuit breaker in driver's control panel junction box and is shown on "Coach Lighting Wiring Diagram." Bulb is accessible after removing lens and retainer which are secured to light body with three screws.

TELL-TALE LIGHTS

Use of tell-tale lights is described under "Tell-tale Alarm System" in "WIRING AND MISCELLANEOUS ELECTRICAL" section. Refer to "Alarm and Signal Wiring Diagram" (MD-88616) for tell-tale circuits.

BAGGAGE COMPARTMENT LIGHTS

Baggage compartment lights are controlled by individual switches as each door is opened and closed. Compartment light circuit is protected by number 24 circuit breaker in driver's control panel junction box. Refer to "Coach Lighting Wiring Diagram" for electrical circuits. Bulbs are accessible after pulling light socket with bulb from light body.

ENGINE COMPARTMENT LIGHTS

Engine compartment lights are controlled by a switch on engine compartment control panel. Compartment light circuit is protected by number 5 circuit breaker in electrical compartment at right rear of coach. Refer to "Coach Lighting Wiring Diagram" for electrical circuits. Bulbs are exposed and are readily accessible for replacement.

AIR CONDITIONING CONDENSER COMPARTMENT LIGHT

Air conditioning condenser compartment light, used to illuminate condenser compartment, is automatically illuminated when engine is running, "VENTILATION" switch is in "AIR CONDITION" position and hinged condenser coil is unlatched. Circuit is protected by number 1 circuit breaker in driver's control panel junction box. Refer to "Heating and Air Conditioning Wiring Diagram" for electrical connections. Bulb is exposed and is readily accessible for replacement.

VENTILATION COMPARTMENT LIGHT

Ventilation compartment light, used to illuminate ventilation compartment, is controlled by switch located on side of control bracket hanging from ceiling of outer compartment. Circuit is fed directly from ventilation compartment battery junction and is shown on "Heating and Air Conditioning Wiring Diagram." Bulb is exposed and is readily accessible for replacement.

REFRIGERANT LEVEL SIGHT GLASS LIGHT

Refrigerant level sight glass light, controlled by a switch inside opening for viewing glass, is mounted on top of receiver tank assembly. "VENTILATION" switch must be in "AIR CONDITION" position before light can be operated by switch. Circuit is protected by number 1 circuit breaker in driver's compartment junction box and is shown on "Heating and Air Conditioning Wiring Diagram." Bulb is accessible for replacement after removing metal cover from top of tank and pulling light and socket from tank.

EMERGENCY DOOR LIGHT (WHEN USED)

Emergency door light, mounted above emergency door, is operative when "MASTER" switch is in "NITE" or "PARK" position. Light circuit is protected by number 13 circuit breaker in driver's control panel junction box and is shown on "Coach Lighting Wiring Diagram." A tell-tale light, on driver's gauge and tell-tale panel, is incorporated in circuit to warn driver when door is open.

Refer to next page for Light Bulb Data.

LIGHT BULB DATA

(All Bulbs Are Single Contact Unless Otherwise Noted)

Name	Qty.	Candlepower or Watts	Trade No.
Headlight Sealed-Beam Unit			
(Inside—Stamped No. 1)	2	37.5W	4006
(Outside—Stamped No. 2)	2	37.5-50W	4005
Instrument Panel Lights	4	2	57
Tell-tale Lights	13	2	57
Rear License Plate Lights	2	4	67
Corner Marker Lights	4	6	89
Michigan Marker Lights	6	4	67
Front Destination Sign Lights	4	15	93
Side Destination Sign Lights	2	6	89
**Emergency Door Light	1	1	53
**Seat Lights	6	2	57
Entrance Door Step Light	1	21	1141
Taillights	2	4	67
Baggage Compartment Lights	5	15	93
Engine Compartment Lights	4	15	93
Driver's Light	1	15	93
Night Light	2	4	67 Blue
Fog Lights	2	32	1011
Front Turn Signal Lights	2	21	1141
Rear Stop & Turn Signal Lights	2	21	1141
Reading Lights	40	15	93 I.F.
General Lights	18	15	93 I.F.
Lounge Seat Light	1	21	1141 I.F.
Freon Receiver Tank Light	1	6	89
Spot Light	1	30W	4435
**Lavatory (Interior) Light	1	21	1141 I.F.
**Lavatory Nite Light	1	4	67
Heating and A C Comp't Light	1	15	93
**Lavatory Occupied Sign Lights	2	2	57
*Side Clearance Lights	8	4	68
A/C Condenser Compartment Light	1	15	93

(*) Double Contact
(**) Special Equipment

Diesel Engine

Coach is powered by 8V-71 Diesel engine. Engine, transmission, and radiator comprise a unit power plant which is supported on engine cradle assembly and installed transversely in engine compartment at rear of coach (fig. 1).

This section of manual covers description and maintenance of engine accessories which are not included in 8V-71 DIESEL ENGINE MAINTENANCE MANUAL or in other sections of this manual. Also included is the procedure for replacing the complete power plant and cradle assembly. Refer to ELECTRICAL SYSTEM (SEC. 7) for information on wiring and electrical units such as generator and starter.

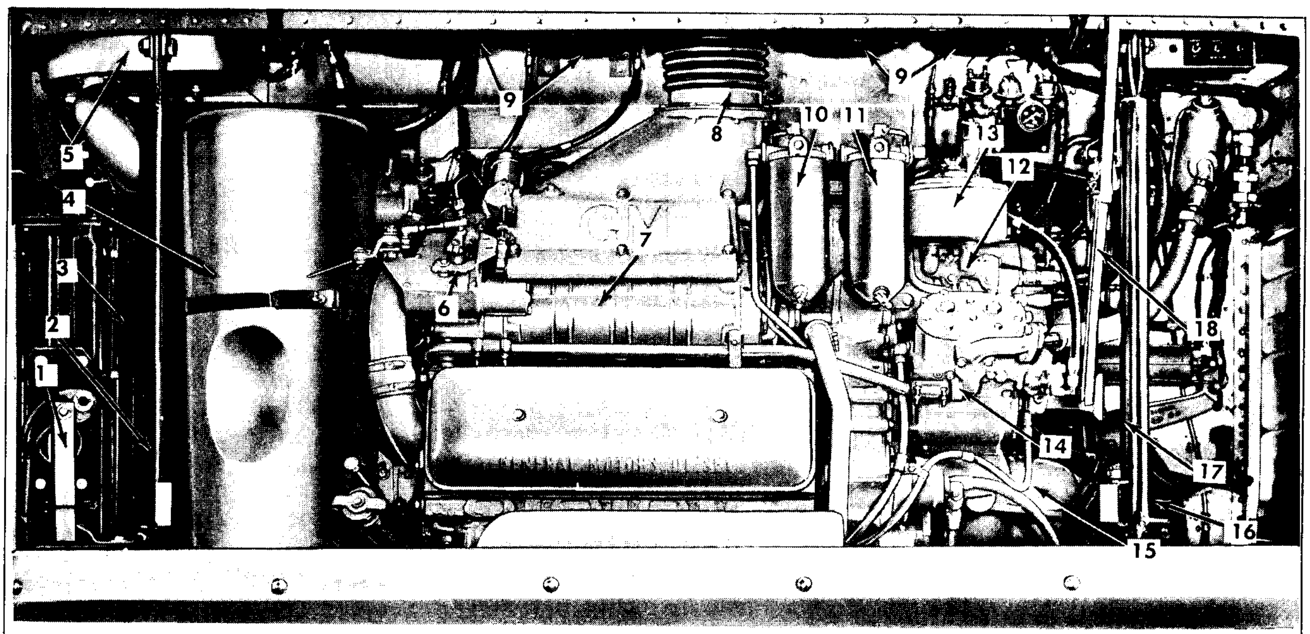
Maintenance of cooling system units is covered in COOLING SYSTEM (SEC. 6), while fuel system maintenance procedures are in FUEL SYSTEM (SEC. 12) in this manual. Engine general data is given at end of this section.

ENGINE ACCESSORIES

Accessories described in this section are used either as standard or special equipment and are not included in the current Diesel Engine Maintenance Manual or in other sections of this manual.

OIL PRESSURE GAUGE

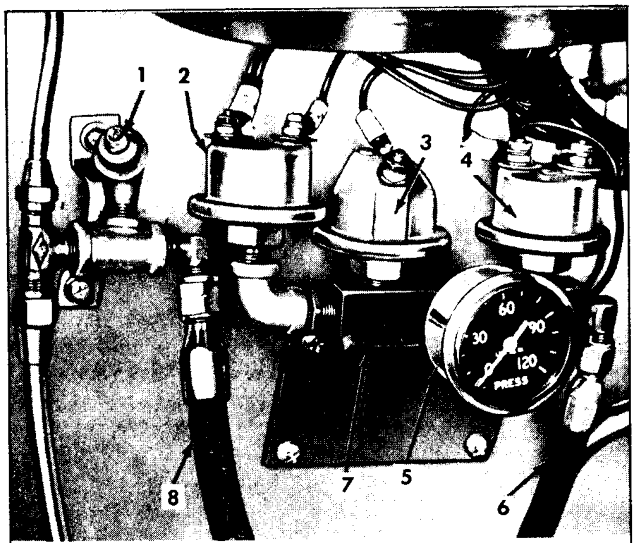
An oil pressure gauge is installed in oil pressure sending manifold on engine compartment bulkhead (fig. 2) for use when working on engine.



1 Radiator Closure Latch
2 Engine Cradle Hanger - Left
3 Radiator Assembly
4 Muffler
5 Radiator Surge Tank
6 Engine Governor
7 Engine Blower
8 Air Intake
9 Air Cleaners
10 Secondary Fuel Filter
11 Primary Fuel Filter
12 Power Steering Pump
13 Power Steering Fluid Tank
14 Air Compressor
15 Clutch Housing
16 Transmission
17 Engine Cradle Hanger - Right
18 Door Support

TPM-8672-1

Figure 1—Power Plant, Accessories, and Controls Installed



1 Air Supply Valve
2 Air Cond. Oil Pressure Control Switch
3 Oil Pressure Sending Unit
4 Low Oil Pressure Switch
5 Oil Pressure Gauge
6 Oil Pressure Line
7 Oil Pressure Manifold
8 Air Line TPM-8501

Figure 2—Oil Pressure Gauges and Manifold

The registering gauge at driver's instrument panel is electric type interconnected with sending unit at oil pressure manifold in engine compartment. Electric oil gauge circuit is operative only when the "MASTER" switch is in "DAY" or "NITE" position. See "Alarm and Signal Wiring Diagram" at back of book.

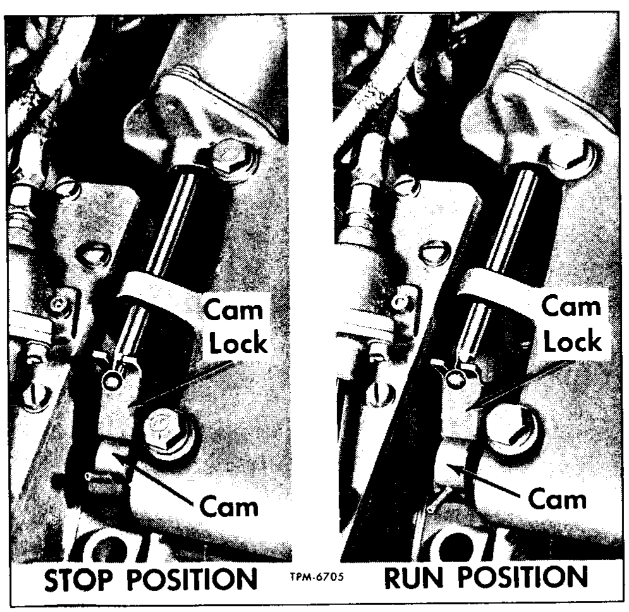


Figure 3—Emergency Stop Mechanism

TEST

In case electric oil gauge fails to function or if it gives an apparent false reading, system may be checked as follows:

1. Disconnect wire from engine unit and connect a test lamp of not more than 2 C.P. between battery terminal of starter solenoid and body of the unit. If lamp fails to light, the unit is not grounded, and the threaded hole and the threads on the unit should be checked for metal to metal contact. If the lamp lights the unit can be considered grounded. (DO NOT USE A LAMP OF OVER 2 C.P.)

2. Remove the wire from the unit terminal and connect the test lamp between the unit terminal and the battery post on the starter solenoid. If lamp lights, start engine and observe if lamp changes intensity. A satisfactory unit will change the lamp intensity at different engine speeds. (Changes in oil pressure.)

3. Replace the wire and check wiring for open circuit between unit and gauge on instrument panel, referring to "Alarm and Signal Wiring Diagram."

4. If units and circuits pass above tests, replace the gauge and check for operation at various engine speeds.

5. Do not attempt repairing gauge or sending unit. When replacing sending unit do not use thread compound as this will prevent proper ground and cause faulty gauge reading.

LOW OIL PRESSURE SWITCH

Low oil pressure electrical switch is installed in oil pressure sending manifold (fig. 2), which is mounted on engine compartment bulkhead. Manifold is connected with engine oiling system by a flexible tube.

When engine is running, the oil pressure acts upon a diaphragm to hold a pair of switch contacts open. However, if pressure should drop below 3 to 4 lbs., points will close completing circuit. When points close, tell-tale alarm buzzer sounds, and low oil tell-tale light illuminates. Whenever alarm buzzer sounds or low oil tell-tale lights, stop engine immediately and correct cause of low pressure.

CIRCUIT TEST

Low oil pressure indicating system is interconnected with control switch so that system is inoperative when control switch is off.

With "MASTER" switch in "DAY" or "NITE" position, and engine not running, low oil pressure tell-tale light should be illuminated and buzzer should sound. If buzzer sounds and light does not illuminate, replace bulb. If light is illuminated and buzzer does not sound, check the alarm buzzer.

If light fails to illuminate and buzzer fails to sound with master control switch turned on, momentarily connect the two wire terminals at pressure switch. Failure of tell-tale lights or buzzer to sound indicates that the circuit to these units is at fault. Refer to "Alarm and Signal Wiring Diagram" in back of manual for electrical circuit.

SOLENOIDS

Emergency stop solenoid assembly (figs. 3 and 4) is installed at engine blower housing and releases a choke valve to shut off air and stop engine in case engine cannot be stopped by normal means.

For normal use to stop engine, a solenoid valve (fig. 5) on bulkhead in engine compartment is used to admit air pressure to air cylinder which actuates lever on governor housing and moves engine injectors to no-fuel position. This mechanism operates automatically when master control switch is turned "OFF."

A fast idle solenoid valve, mounted on engine bulkhead as shown in figure 5, is used to admit air to fast idle air cylinder and limiting cylinders. Solenoid valve is operative only when switch at left of driver is in "FAST IDLE" position and parking brake is applied.

EMERGENCY STOP SOLENOID

Key numbers refer to figure 4.

Solenoid assembly components can be replaced as necessary when repairing the assembly.

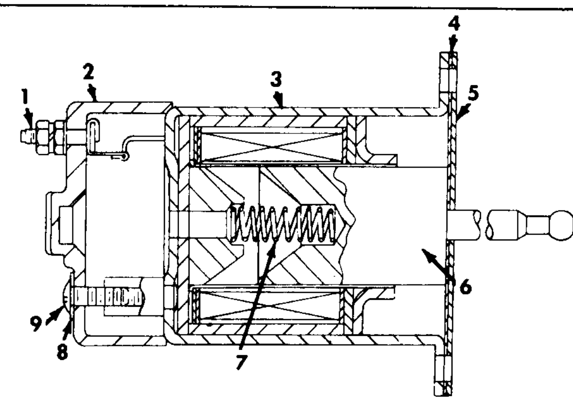
Disassembly

1. To remove solenoid assembly from engine, wires must be disconnected from terminal and cam lock must be removed. Remove two mounting bolts holding solenoid assembly to blower housing.
2. Bend tangs on case (3) to permit removal of plate (5). Remove plate and gasket (5 and 4). Remove plunger and rod assembly (6) from case and coil assembly (3). Remove spring (7).
3. Remove screw (9) and washer (8) to permit inspection of coil wire attached to terminal (1).

Assembly

1. Be sure coil wire is securely attached to lug on terminal (1), then install cover (2) on case and coil assembly (3), and attach with two screws (9) and washers (8).
2. Place spring (7) in counterbore in plunger, then insert plunger into place in case and coil assembly. Slide plate (5) with gasket (4) on solenoid rod and bend tangs on case to hold plate (5) in place.
3. Insert plunger rod through guide on blower housing, and install two mounting bolts. Engage cam lock with plunger rod and bolt lock to blower housing. Attach wire to terminal (1). Figure 3 shows the solenoid and mechanism installed.

NOTE: Cam (fig. 3) must be set in "run position" before engine can be started.

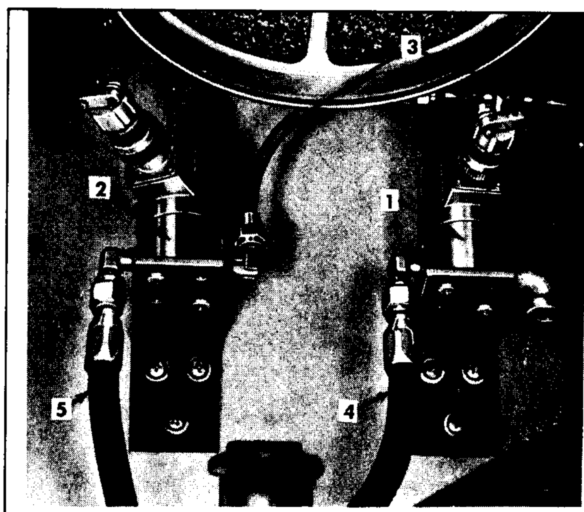


1 Wire Terminal
2 Cover
3 Case and Coil Assy.
4 Gasket
5 Plate
6 Plunger and Rod Assy.
7 Plunger Spring
8 Washer
9 Cover Screw
TPM-7065

Figure 4—Emergency Stop Solenoid

ENGINE STOP AND FAST IDLE SOLENOID VALVES

Solenoid valve shown in figure 6 can be disassembled for cleaning and inspection. Plunger, spring, and seals are available for service replacement.



1 Engine Stop Solenoid
2 Fast Idle Solenoid
3 Air Pressure Line
4 To Engine Stop Cylinder
5 To Fast Idle and Limiting Cylinders
TPM-7760

Figure 5—Engine Stop and Fast Idle Solenoids Installed on Bulkhead

Disassembly

1. Remove threaded connector (10) and seal (11) from bottom of valve assembly, then remove thin nut (9) which holds housing and coil assembly to sleeve assembly (5).

2. Remove housing and coil assembly by sliding off lower end of sleeve assembly.

3. Using spanner wrench (Skinner #VO-233) remove sleeve, plunger, and spring (5, 2 and 3) from valve body (1).

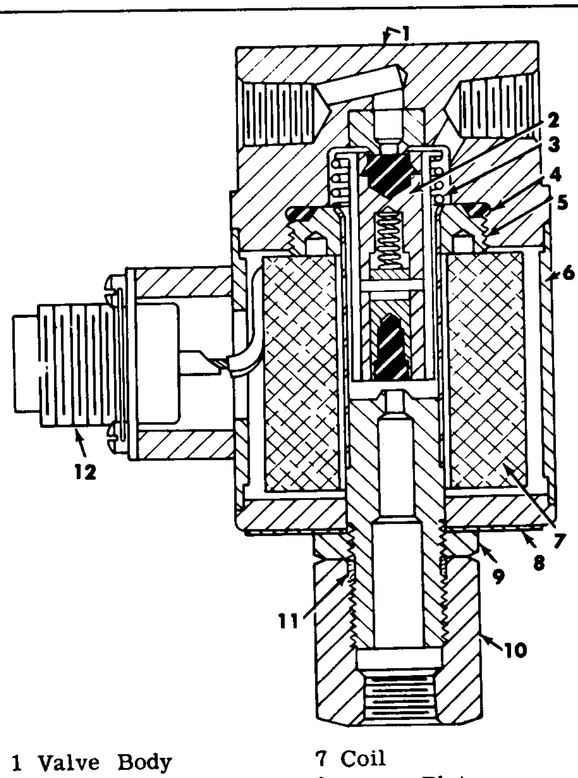
4. Separate plunger and spring from sleeve and remove seal (4) from valve body.

NOTE: Seals (4 and 11) should be discarded and new seals should be obtained for use when assembling valve.

Assembly

Examine valve seats and mating surfaces and check condition of spring. Obtain new parts as required and follow directions below to assemble.

1. Assemble spring (3) on plunger (2), then insert plunger into sleeve assembly (5).



1 Valve Body
2 Plunger Assembly
3 Spring
4 Sleeve Seal
5 Sleeve Assembly
6 Housing
7 Coil
8 Name Plate
9 Sleeve Nut
10 Connector (Air Inlet)
11 Connector Seal
12 Wiring Connector
TP-9079

Figure 6—Engine Stop and Fast Idle Solenoid Valve

2. Place new seal (4) in valve body, then screw sleeve into body using spanner wrench.

3. Assemble housing and coil assembly over sleeve, then install name plate (8) and sleeve nut (9).

4. Place new seal (11) in groove in sleeve, then install connector (10) and tighten while holding nut (9).

CAUTION: Overtightening nut (9) will put excessive stress on sleeve; tighten nut only as necessary to seat parts solidly.

ENGINE CONTROL AIR CYLINDERS

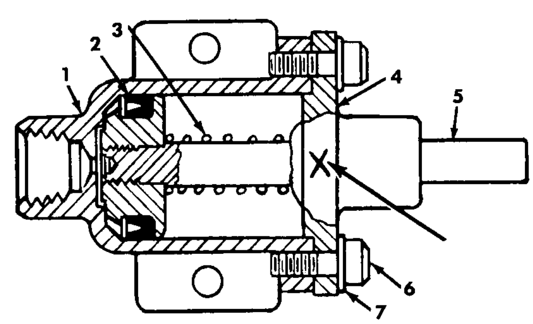
ENGINE STOP AIR CYLINDER

Engine shut-off cylinder (typically illustrated in fig. 7) is mounted on governor (fig. 8) with piston rod aligned with stop lever on governor shaft. When "MASTER" control switch is turned to "OFF" position, the engine stop solenoid valve on engine compartment bulkhead panel is de-energized and spring moves valve plunger to close exhaust passage and open air inlet passage in valve. With air pressure applied to shut-off cylinder the piston pushes rod out against governor lever and moves engine injector racks to no-fuel position, thereby stopping engine.

FAST IDLE LIMITING AIR CYLINDER

NOTE: Limiting cylinder uses a return spring and cylinder assembly is identified with an "X" (fig. 7).

An air cylinder (fig. 7) is mounted on engine governor (fig. 8) which operates in conjunction with fast idle air cylinder, to control engine fast idle RPM at terminals. Whenever fast idle air cylinder operates to increase engine RPM, air is also applied to limiting cylinder and plunger comes against throttle control lever to limit engine RPM.



1 Cylinder
2 Piston Cup
3 Return Spring (Limiting Cylinder)
4 Cylinder Cap
5 Piston Rod
6 Cap Screw
7 Lock Washer
TPM-7858

Figure 7—Engine Stop and Fast Idle Limiting Air Cylinder

AIR CYLINDER REPAIR
Key numbers in text refer to figure 7.

Disassembly
1. Disconnect air line from air cylinder.
2. Remove two socket-head bolts which mount cylinder on governor cover, then remove air cylinder.
3. Remove two screws and lock washers (6 and 7) which secure cap (4) on cylinder (1). Remove cap (4) and spring (3) from piston rod.
4. Pull piston and rod assembly out of cylinder.
5. Clean and inspect components.

Assembly
1. Lubricate piston cup (2) and bore in cylinder (1).
2. Insert piston and rod assembly into cylinder bore using care to prevent damage to piston cup (2).
3. Install spring (3) on piston rod, then install cap (4) on cylinder. Use lock washers (7) under heads of cap screws (6) and tighten screws to secure cap (4) on cylinder (1).
4. Install the cylinder assembly on governor cover, and connect air line to cylinder.

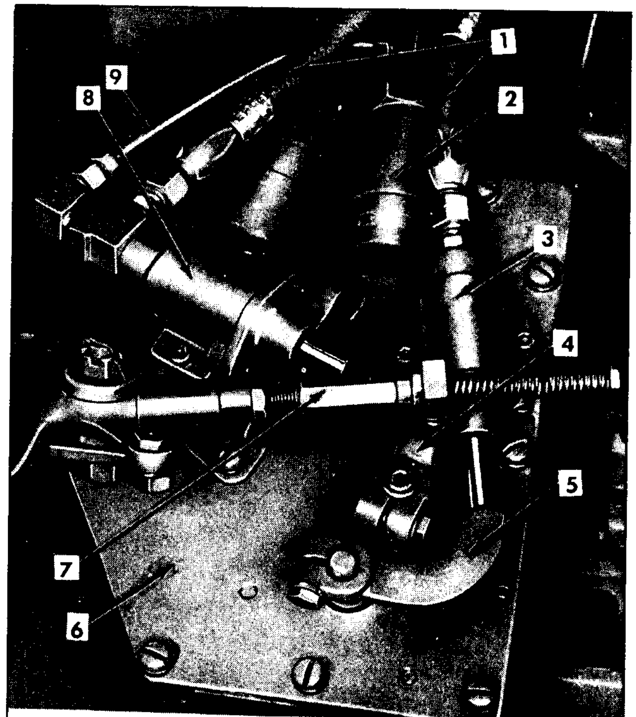
FAST IDLE AIR CYLINDER

A fast idle air cylinder (fig. 9) is installed in governor as shown in figure 8. Function of cylinder is to accelerate engine speed when vehicle is stopped at terminals. The additional engine RPM are required to keep air conditioning system functioning during terminal stops.

Air cylinder operates only when a toggle switch at left of driver is in "FAST IDLE" position and parking brake is in applied position.

REPAIR
Key numbers in text refer to figure 9.

Disassembly
1. Disconnect air line from cylinder.
2. Loosen jam nut (3), then thread assembly out of governor housing.
3. Remove plunger (2) from cylinder.
4. Remove retainer ring (11) from end of cylinder.
5. Remove inlet plug (12) and O-ring (10) from cylinder.
6. Remove piston (7), and O-ring (10) assembly, also spring (9).
7. Remove follower retaining ring (5) from piston, then remove follower (6), and spring (8) from piston.
8. Remove O-ring from inlet plug and piston, and discard.

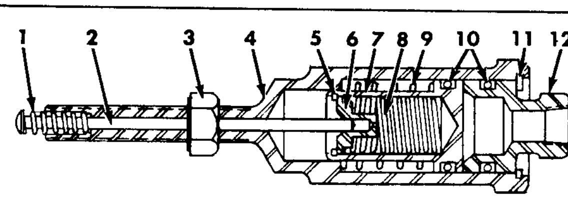


1 Air Lines
2 Fast Idle Air Cylinder
3 Engine Stop Air Cylinder
4 Throttle Lever
5 Stop Lever
6 Governor Cover
7 Throttle Link
8 Fast Idle Limiting Air Cylinder
9 Air Tube

TPM-8502

Figure 8—Governor Cover and Controls

Assembly
1. Clean all parts in suitable cleaning fluid to remove all trace of oil or dirt, then dry.
2. Lubricate cylinder walls and O-rings with Lubriplate or equivalent.
3. Install spring (8), and follower (6) in piston and secure with ring (5).
4. Install O-rings (10) in piston and inlet plug.



1 Plunger Spring
2 Plunger
3 Jam Nut
4 Cylinder
5 Follower Ring
6 Spring Follower
7 Piston
8 Follower Spring
9 Piston Spring
10 O-Rings
11 Retaining Ring
12 Inlet Plug

TPM-8506

Figure 9—Fast Idle Air Cylinder

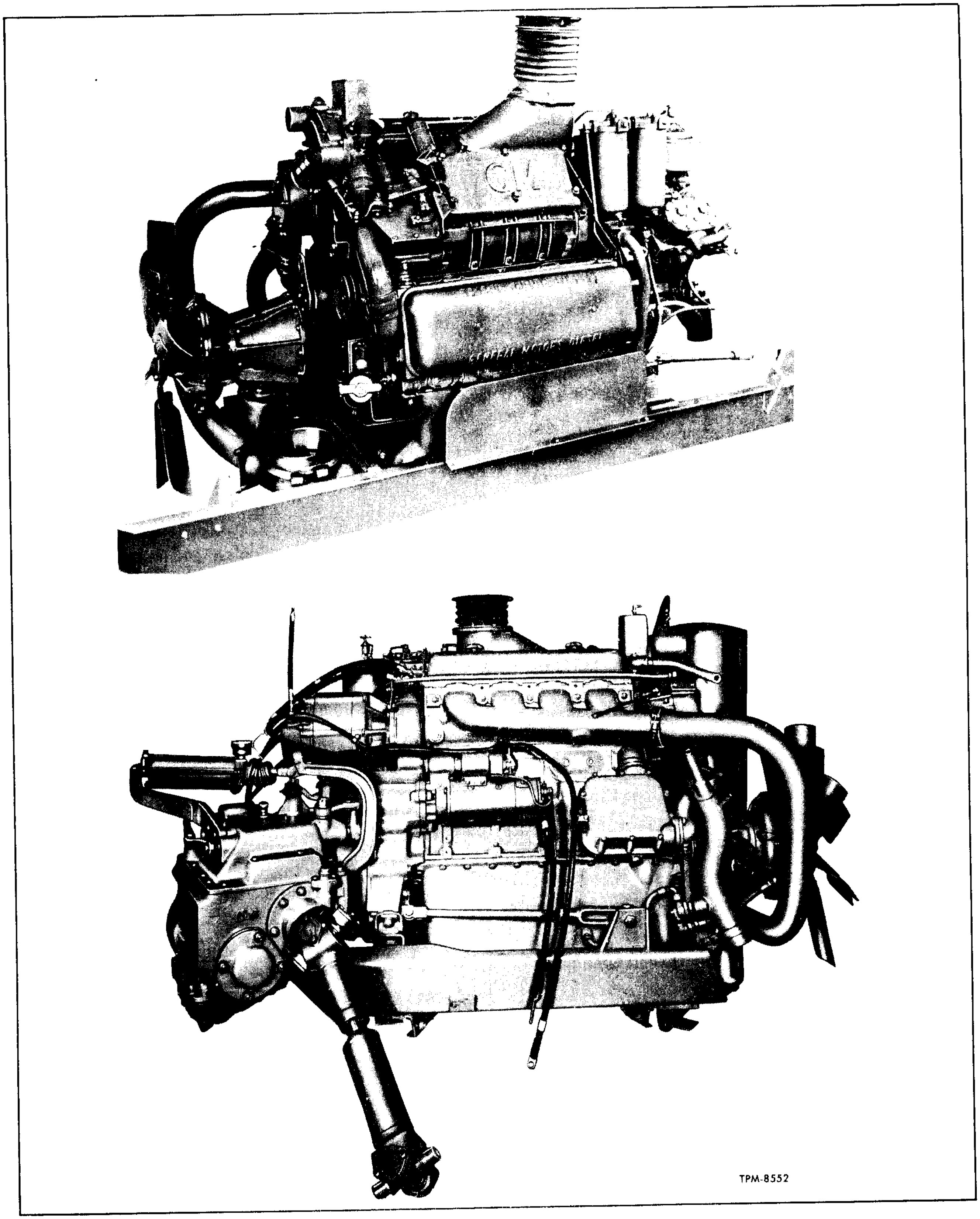


Figure 10—Power Plant Removed

5. Locate piston spring (9) in cylinder, then install piston assembly and inlet plug. Secure inlet plug and piston in cylinder with retaining ring(12).

6. Install plunger spring (1) and plunger (2) in cylinder.

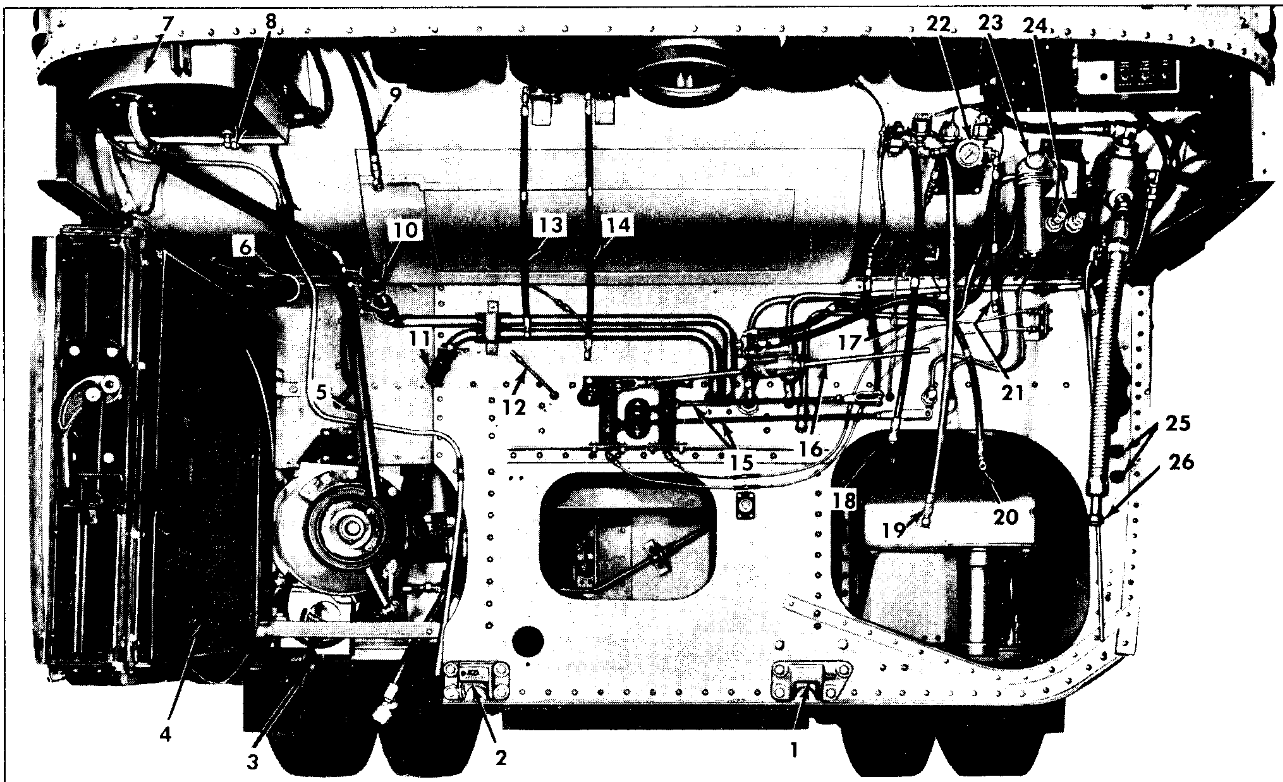
7. Thread assembly into governor housing. Start engine and adjust in same manner as described for "Buffer Spring Adjustment" in "ENGINE TUNE-UP" section of Diesel engine maintenance manual.

ENGINE REPLACEMENT

Power plant (fig. 10) including engine, clutch, and transmission is mounted on engine cradle and is installed transversely at rear of vehicle (fig. 1).

Engine is supported by three cushion type mountings. Clutch housing is bolted to engine and the complete power plant including exhaust system, and rear bumper is supported on cradle. Two stablizer rods (fig. 12) anchor the engine in position on cradle.

Brackets (fig. 11) at lower edge of bulkhead support the front side of cradle, while rear side is supported by two hanger assemblies suspended from support beam at rear of coach body. Instructions which follow describe method of replacing the complete power plant assembly. A special dolly must be used to support power plant at cradle, and provide a means for moving assembly out of engine compartment. Refer to figure 11 for location of various disconnect points in replacing power plant.



1 Engine Cradle Support - Right
2 Engine Cradle Support - Left
3 Radiator Outlet
4 Radiator Assembly
5 Pump Return Line
6 Radiator Inlet
7 Surge Tank
8 Cooling System Filling Line
9 Cooling System Deaeration Line
10 Heater Feed Line
11 Heater Return Line
12 Accelerator Cable
13 Engine Control Air Line
14 Engine Stop Air Line
15 Transmission Control Rods
16 Clutch Control Rod
17 Air Line
18 Speedometer Cable
19 Moisture Ejector Valve Air Line
20 Clutch Air Line
21 Oil Pressure Line
22 Oil Pressure Gauges and Manifold
23 Power Steering Fluid Lines
24 Fuel Line Connections
25 Electrical Amphenol Plugs
26 Air Compressor Discharge Line

TPM-8551

Figure 11—Engine Compartment Showing Disconnect Points

POWER PLANT REMOVAL

Key numbers in text refer to figure 12 unless otherwise indicated.

1. Remove dust shields below power plant, and drain cooling system, referring to COOLING SYSTEM (SEC. 6) for draining procedure.

NOTE: Before proceeding with removal operations, disconnect battery cables and exhaust air from air system at tank located forward of left rear wheel.

2. Raise radiator closure door and closure door at right side of engine compartment.

3. Remove engine compartment rear door by detaching door hinges by removing cotter pin and straight pin attaching hinge to body.

4. Disconnect air lines (13 and 14) between engine stop and fast idle solenoids and engine governor.

5. Disconnect accelerator control cable (12) from governor.

6. Disconnect oil line (21) to pressure manifold at generator.

7. Disconnect two fuel lines (24) at junction bracket on engine. Tag each line so that it can be reinstalled in the original location.

8. Disconnect air compressor and governor discharge lines (17 and 26)

9. Disconnect two power steering fluid lines (23). Seal all openings to prevent entry of dirt. Tag each line so that they can be reinstalled in their original location.

10. Disconnect blower air intake hose from air chamber.

11. Disconnect two heater lines (10 and 11) and surge tank hose (5) by loosening hose clamps.

12. Disconnect upper and lower radiator hoses (3 and 6).

13. Disconnect two surge tank to engine manifold lines (8 and 9).

14. Disconnect two transmission control rods (15) from levers on transmission control cover.

15. Disconnect clutch control rod (16) from clutch operating lever.

16. Disconnect clutch operating valve air supply line (20).

17. Disconnect wiring by separating two halves of two amphenol plugs (25).

18. Disconnect speedometer cable (18) at transmission.

19. Disconnect propeller shaft at slip joint by loosening dust cap.

20. Disconnect generator cable from junction on engine bulkhead.

21. Disconnect starter cable from junction on engine bulkhead.

22. Disconnect ground strap from transmission or body junction.

SAFETY CAUTION

Before proceeding with step 23 below, block coach body securely. When adjusting dolly to take weight of power plant, the coach body may be inadvertantly raised just enough to cause height control valves to exhaust, in which case entire weight of rear end of coach will be placed on dolly.

23. Position engine dolly under cradle and adjust to take weight off support hangers, then remove bolts at upper end of each support hanger and remove bolts from cradle brackets (1 and 2). Move power plant away from engine compartment slowly, meanwhile checking as necessary to see that all lines, wiring, and controls are disconnected.

24. Transmission assembly may be removed by following instructions in TRANSMISSION (SEC. 17) of this manual. Diesel engine may be lifted off cradle using lifting brackets provided at cylinder head.

Refer to 8V-71 DIESEL ENGINE MAINTENANCE MANUAL for repair information covering fluid fan drive mechanism.

ENGINE CRADLE AND MOUNTING INSPECTION

1. Inspect cradle members and engine front support members for wear and possible fractures. Repair or replace as necessary.

2. Check condition of bulkhead brackets and bolts. Replace as necessary.

ENGINE MOUNTINGS

1. Inspect engine front mounting bushings (fig. 13). If bushings are deteriorated or damaged, replace bushings.

2. Inspect engine rear mounting assemblies and engine stabilizer rods (fig. 11). If mountings are oil-soaked or show evidence of failure, replace mountings.

INSTALLING POWER PLANT

Key numbers in text refer to figure 12 unless otherwise indicated.

Make necessary repairs to exhaust system units before installing power plant. Fluid fan drive mechanism, clutch, and transmission assembly should be assembled to engine, since attaching parts are readily accessible with power plant removed. Refer to applicable section in this manual for details and procedure for installing engine accessories.

The steps listed below should be followed in the order given to install power plant.

1. Move power plant assembly into position,

with propeller shaft splines engaged and, with cradle engaging brackets (1 and 2). Install bolts with nuts at bulkhead brackets.

2. Install support hangers and connect at brackets. Tighten all bolts including those at bulkhead brackets firmly.

3. Remove dolly from cradle.

4. Connect air lines (13 and 14) between engine stop and fast idle solenoids and respective cylinder assemblies on engine governor.

5. Connect accelerator control cable (12) at governor operating bell crank.

6. Connect generator to pressure manifold oil line (21).

7. Connect two fuel lines (24) at junction bracket on engine. Be sure they are installed in their original location.

8. Connect air compressor and governor discharge lines (17 and 26).

9. Connect two power steering fluid lines (23) at junction bracket on engine. Be sure they are installed in their original location.

10. Connect blower intake hose to body air intake compartment.

11. Connect two heater lines (10 and 11) to engine, also connect surge tank line (5) to engine.

12. Connect radiator to engine inlet and outlet, upper and lower, hoses (3 and 6).

13. Connect two surge tank to engine manifold lines (8 and 9).

14. Connect two transmission control rods (15) to levers on transmission control cover.

15. Connect clutch rod (16) to clutch operating lever.

16. Connect air line (20) to clutch operating cylinder.

17. Connect speedometer cable (18) to transmission.

18. Connect wiring by connecting two halves of amphenol plugs (25).

19. Connect generator cable to terminal on engine bulkhead.

20. Connect starter cable to engine bulkhead.

21. Connect ground strap from transmission to body junction.

22. Fill cooling system as instructed in COOLING SYSTEM (SEC. 6).

23. Start engine and run at fast idle until at operating temperature. During warm-up check for water and oil leaks.

24. Install dust pans below power plant.

25. Install and close engine compartment doors.

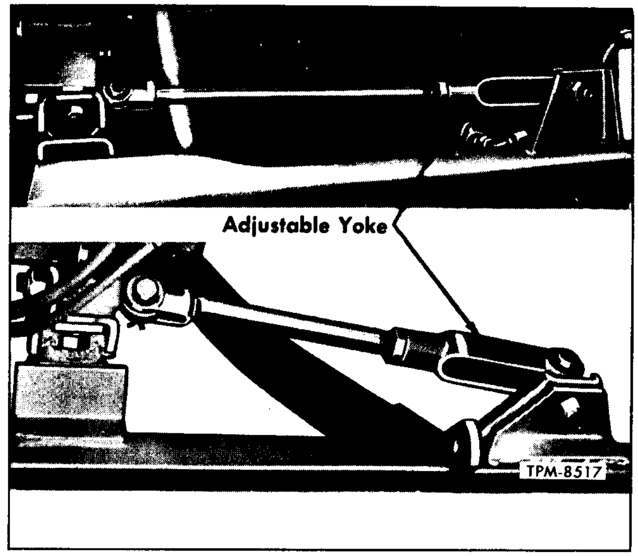


Figure 12—Engine Mountings and Stabilizer Rods

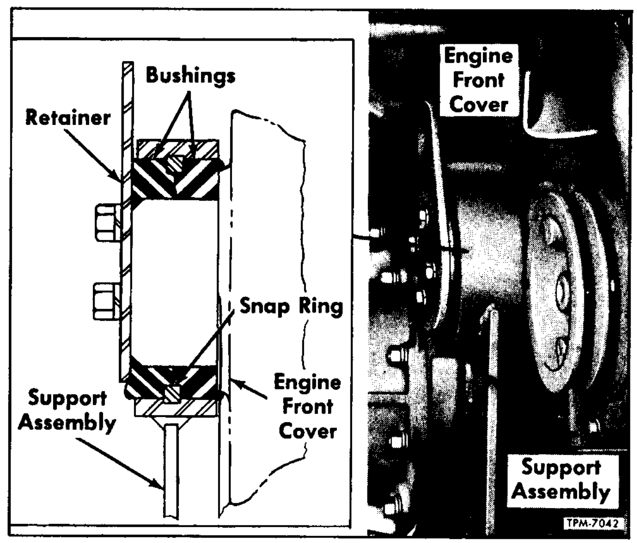


Figure 13—Engine Front Mounting

SPECIFICATIONS

ENGINE	
Model	8V-71
Bore	4¼"
Stroke	5"
Total Displacement (Cu. In.)	567.5
Engine Rotation	Counterclockwise
Firing Order	1L-1R-2L-2R-4L-4R-3L-3R
LOW OIL PRESSURE SWITCH	
Make	AC
Model	1509034
Contacts Break (Lbs. Pressure)	2-3
OIL PRESSURE GAUGE ON INSTRUMENT PANEL	
Make	AC
Type	Electric
Gauge Unit No.	1509089
Sending Unit No.	1506502
Voltage	12
Range (Lbs. Pressure)	0-120
EMERGENCY STOP SOLENOID	
Make	Delco-Remy
Model	1114404
Voltage	12
Current Consumption (Amps.)	11.5-14.0 @ 9 volts
ENGINE STOP AND FAST IDLE SOLENOID VALVES	
Make	Skinner Chuck Co.
Model (Stop)	V5-23150
Model (Fast Idle)	V5-23420
Plunger Spring	
Approx. Free Height	⅜"
Height Under Load of 4.5-5.5 oz.	3/16"

Fuel System

Fuel system units covered in this section include; fuel tank, lines, and filter; accelerator pedal and linkage; air cleaners; and system specifications. Other items, such as; injectors, engine governor, fuel pump, and blower are covered in current Diesel Engine Maintenance Manual.

Description, operation, and maintenance of other units associated with fuel system will be found in "DIESEL ENGINE" (SEC. 8) of this manual.

Approved specifications for Diesel fuel oil will be furnished upon receipt of request.

FUEL TANK AND LINES

Schematic layout of fuel tank, lines and filters is shown in figure 1. Tank is installed in compartment at right side of coach and is equipped with a signaling device which emits a whistling sound as tank is filled. A ball type check valve is used in whistle tube and is so positioned that fuel cannot escape through whistle tube in case vehicle is upset. Two fuel lines run from tank to engine compartment at rear of coach. Pump at engine draws fuel through supply line and primary filter and discharges fuel through secondary filter and into passages in right and left engine cylinder heads. Surplus fuel is returned to tank through return line. Primary and secondary filters are renewable element type. Refer to "Fuel System Maintenance" later in this section for method of servicing. Check valve, located on fuel line bracket in engine compartment, serves to keep supply line full of fuel while servicing filters, and when fuel lines are disconnected in engine compartment.

ACCELERATOR AND LINKAGE

Key numbers in text refer to figure 2.

Accelerator pedal is connected to governor lever at engine by rods, levers and flexible cable which is encased in metal tubing. Figure 2 shows construction of accelerator linkage.

Adjustable stop screw (2) in floor limits pedal travel. A bellows type boot (10) is used at cable sliding ends to exclude dust and dirt. Linkage at front end is accessible through compartment door at left front corner of coach; and rear end can be reached in engine compartment. Whenever cable is removed from conduit, it must be cleaned and lubricated.

ACCELERATOR LINKAGE REPLACEMENT

Key numbers in text refer to figure 2.

Removal

1. Unhook spring (9) in compartment at front

12

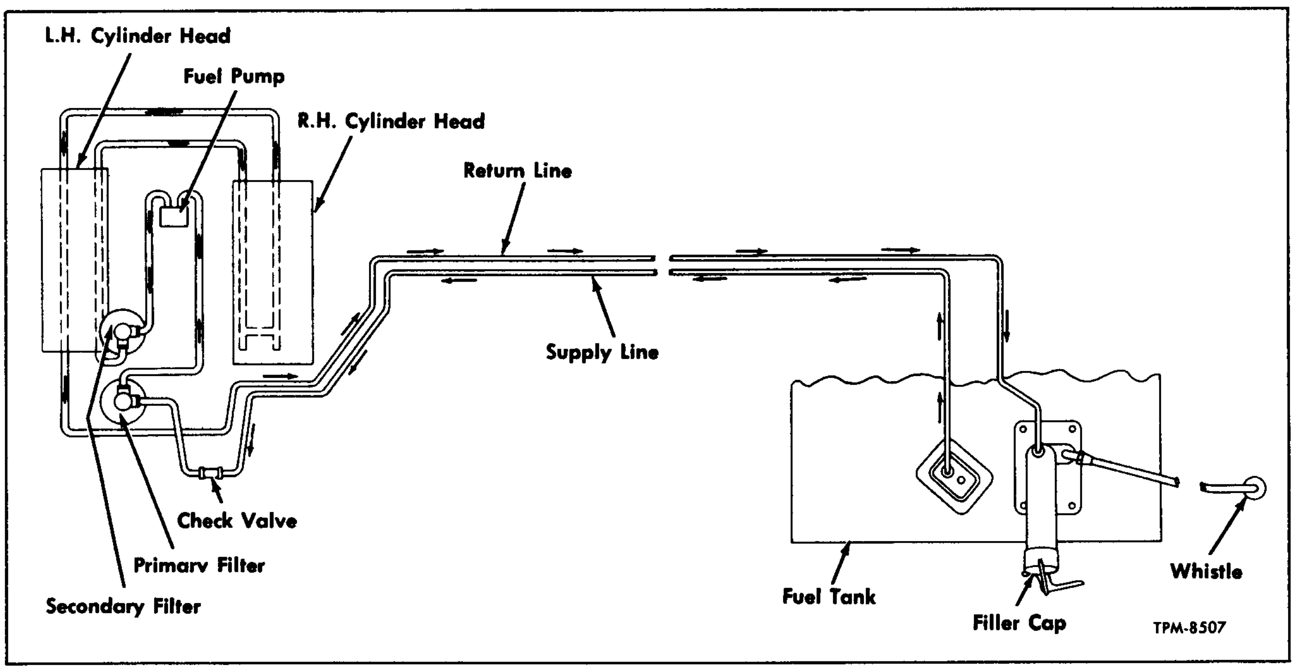


Figure 1—General Arrangement of Fuel Tank, Lines, and Associate Units

end of linkage. Remove clevis pins at both ends of idler lever (4) then remove pin and lever (4).

NOTE: It is not often necessary to remove accelerator pedal, since wear is slight and other linkage components can be removed without removing pedal.

2. Loosen cable lock clamp (7) and slide clamp endwise, then remove lock from sliding end outer tube (8). Disengage boot (10) from groove at swivel assembly, then remove outer tube (8), yoke (6), and boot from sliding end tube.

3. In engine compartment, remove clevis pin attaching yoke (12) to governor bell crank (13). Disengage boot from groove in swivel assembly, then pull cable from conduit with sliding end outer tube and boot attached to cable. Remove clamp (7) to separate outer tube (8) from cable.

4. If inspection indicates that conduit or flexible connector requires replacement, the damaged section may be removed by separating conduit sections at connectors.

Cleaning and Inspection

1. Wash cable in suitable cleaning solvent to remove old lubricant.

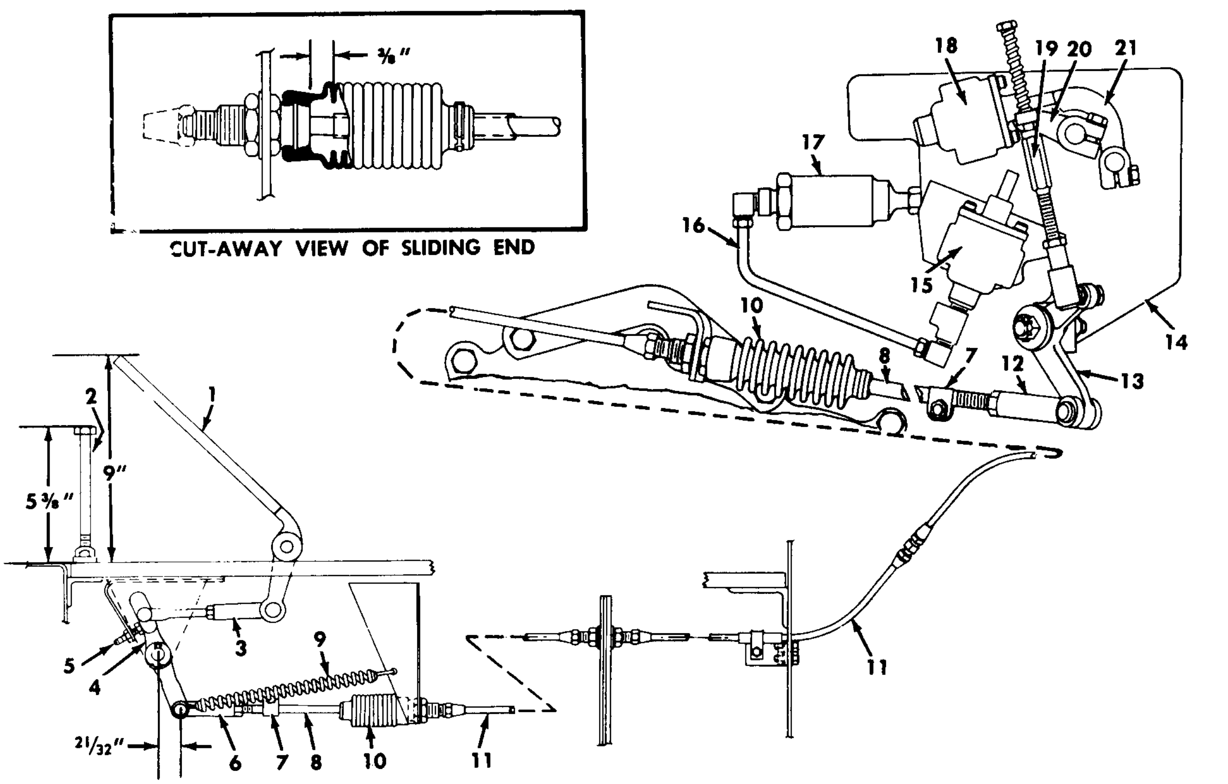
2. Carefully examine cable for kinks and for broken strands. If any damage is evident, new cable must be installed. Overall length of cable is 410". Ends of new cable must be chamfered by grinding. To prevent frayed windings, grinding must be done only in direction of outer windings.

3. Inspect cable conduit for breaks, dents, and flat spots. Any condition which would prevent free movement of cable necessitates replacing damaged section of conduit.

CAUTION: When replacing conduit, make sure it is clean and that cable will pass through it freely. Use extreme care in installing conduit to prevent bending or flattening.

Installation and Adjustment

Swivels and surface of each sliding end must be lubricated as instructed in LUBRICATION (SEC.



1 Accelerator Pedal
2 Pedal Stop Screw
3 Adjustable Yoke
4 Idler Lever
5 Stop Screw
6 Adjustable Yoke
7 Cable Lock Clamp
8 Sliding Tube (Outer)
9 Return Spring
10 Boot
11 Cable Conduit
12 Adjustable Yoke
13 Governor Bell Crank
14 Governor Cover
15 Fast Idle Control Cylinder
16 Air Transfer Tube
17 Fast Idle Cylinder
18 Engine Stop Cylinder
19 Throttle Yield Linkage
20 Throttle Lever
21 Stop Lever

Figure 2—Accelerator Pedal Linkage

13) when assembling accelerator control linkage, and lubricant as specified must be applied to cable as cable is fed into conduit.

Following steps must be performed in sequence as given to assure proper operation of linkage. Key numbers refer to figure 2 unless otherwise indicated.

1. Dip end of cable in lubricant as specified in LUBRICANT (SEC. 13), then feed cable into conduit, applying lubricant to cable as cable is installed. Continue to feed cable into conduit until cable emerges at front end of conduit. Test cable for free movement.

2. In engine compartment, slide boot (10) onto tube (8) then install tube (8) over inner tube. Attach rear yoke (12) to bell crank (13) with clevis pin. Try operating the bell crank to move governor lever from idle to full fuel position. Linkage at governor should move freely.

3. Hold bell crank (13) at the full fuel position and note gap between end of outer tube (8) and swivel. If necessary loosen lock nut at clevis (12) and turn outer tube to adjust gap to 3/8" as shown in cut-away view in figure 2. Tighten lock nut when gap is as specified.

4. Slide boot into position in groove at swivel, then move other end of boot to provide 3" overall length and install boot clamp.

5. Assemble cable lock and clamp (7) to attach cable to sliding end tube (8).

6. In compartment at front of coach, install outer tube (8) and boot (10) over inner tube.

7. Install lever (4) and pivot pin. Check position of lever to be sure that the lower pin hole is 21/32" rearward of pivot pin when lever is against stop screw (5). If necessary, adjust stop screw (5) to obtain this dimension.

8. Connect adjustable yoke (6) to lever (4) us-

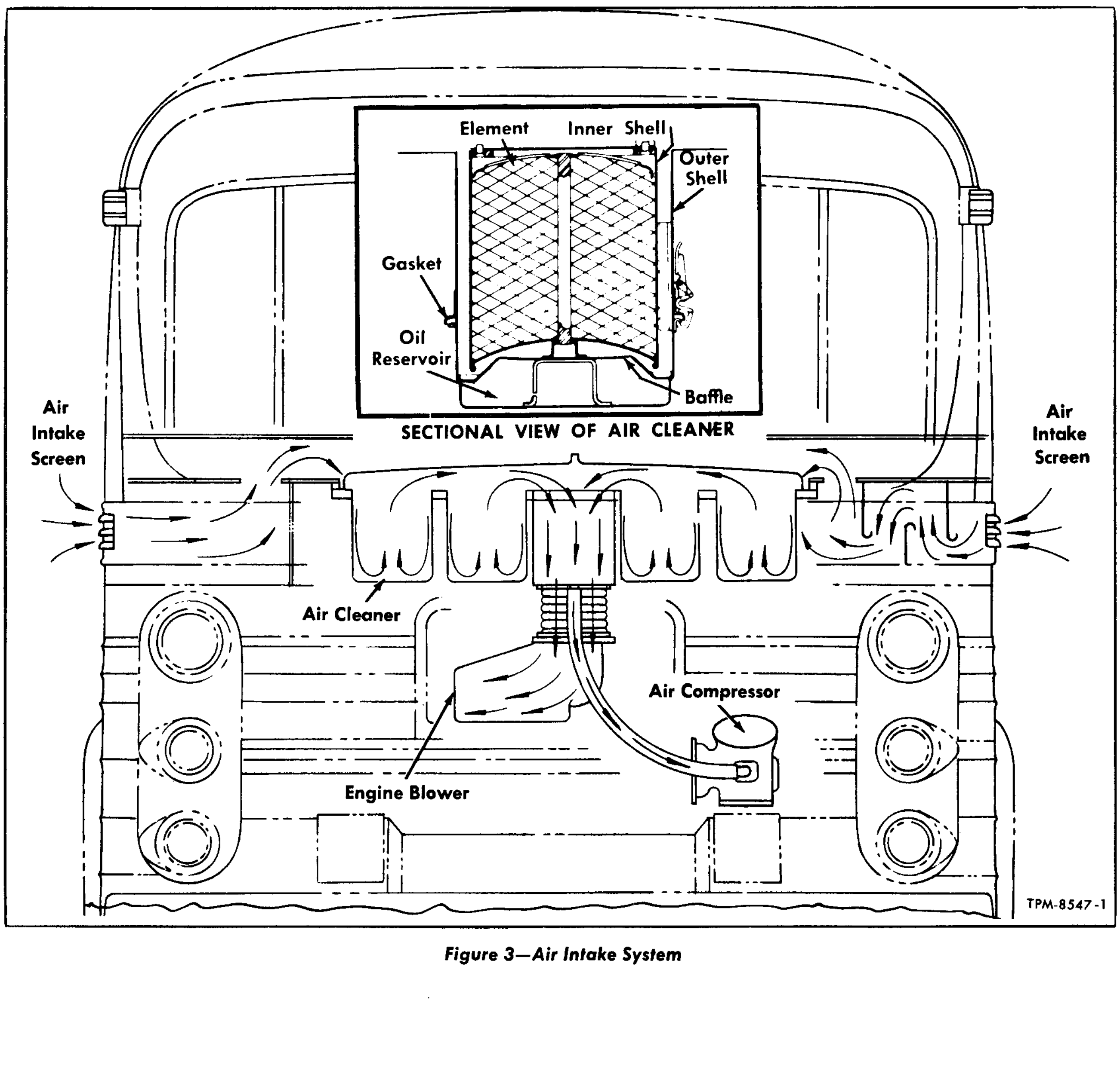


Figure 3—Air Intake System

ing clevis pin. Hold lever (4) against stop screw (5) and measure gap between outer tube (8) and swivel. If necessary loosen lock nut and turn outer tube to adjust gap to 3/8" as shown in cut-away view in figure 2. Tighten lock nut when gap is as specified.

9. Assemble cable lock and clamp (7) to attach cable to sliding end tube (8).

10. Adjust accelerator pedal stop screw (2) to 5-3/8" height.

11. Attach adjustable yoke (3) and link to lower end of accelerator and idler lever (4). Measure height of accelerator pedal end above floor. This dimension should be 9" as shown in figure 2. Adjust yoke (3) as necessary to obtain proper dimension.

12. Install return spring (9).

13. Check operation of accelerator to be sure of full throttle. Slight adjustment at pedal stop screw (2) may be necessary to allow full travel of accelerator linkage.

AIR INTAKE SYSTEM

Air for engine is taken in at rear of coach through screened openings. One opening is provided at each rear corner above engine compartment. At left corner the air intake is through opening in surge tank filler door. Air passes through ducts to air cleaners. From air cleaners, air enters manifold and air silencer chamber, then through flexible hose to blower inlet housing. Arrows on figure 3 indicate direction of air flow. A tube is installed between air compressor and air duct which supplies cleaned air to compressor.

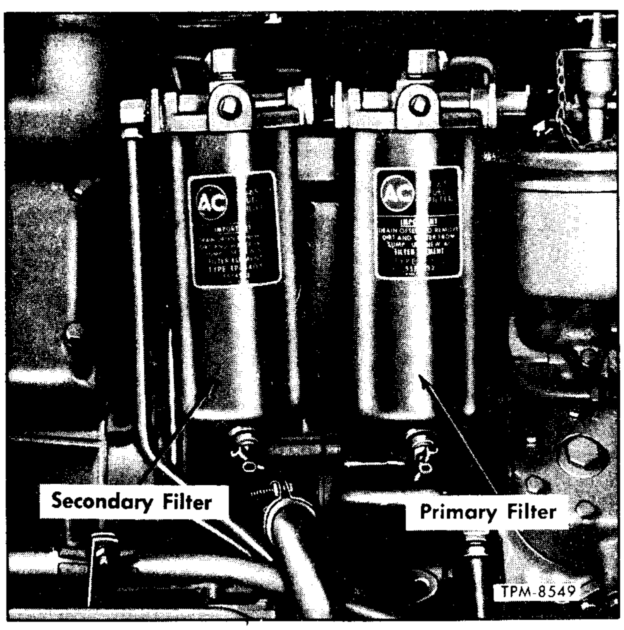


Figure 4—Fuel Filters Installed

AIR CLEANERS

Four heavy duty oil bath air cleaners (fig. 3) mounted on air cleaner manifold are used to remove dust and dirt from air before it reaches blower on engine. Air cleaners are accessible from engine compartment after compartment rear door is raised. Refer to figure 3 for cross-section view of air cleaner. Refer to "Servicing Air Cleaners" under "Fuel System Maintenance" later in this section for method of servicing air cleaners.

FUEL SYSTEM MAINTENANCE

SERVICING FUEL FILTERS

Two fuel oil filters, mounted on engine as shown in figure 4, are sectionally illustrated in figures 5 and 6.

Primary filter assembly uses a "sock" type element, while secondary filter element is a paper type. Elements are not cleanable and must be replaced whenever their efficiency is impaired due to accumulation of foreign matter. In order for these filters to function properly, they must be given proper care. Service in following manner:

Primary Filter

Primary filter (fig. 5) must be drained frequently because if water is present in the fuel it is most likely to accumulate in this filter. No definite draining periods can be given here, inasmuch as the necessity for draining depends upon the cleanliness of the fuel put into the fuel tank. It is recommended, that a small amount of fuel oil be drained from this filter daily, noting the water content (if any), then from this experience definite draining periods may be established. Drain filter by opening drain cock at bottom of filter. If water in any amount is regularly found in this filter, it is an indication that something is wrong in the method of handling and storing of the fuel oil and a thorough investigation must be made to eliminate the trouble; then the fuel tank lines and both filters should be drained and cleaned. The only water that will normally accumulate in the fuel system is from condensation in the fuel tank.

Replacing Primary Filter

In addition to periodic draining as described in preceding paragraph, element should be replaced and filter should be thoroughly cleaned every 5,000 miles as follows:

1. Open drain cock at bottom of filter and allow filter to drain.

2. Remove bolt at top of filter and withdraw shell and filter element assembly. Lift filter element out of shell.

3. Wash all filter parts, in a suitable cleaning solvent.

4. Inspect filter housing gasket, element gasket, and bolt gasket, replace if not in good condition.

5. Reassemble filter and inspect carefully for leaks. Be sure drain cock is closed tightly.

NOTE: In the event check valve (fig. 1) is removed from primary filter, always reinstall with word "TOP" facing upward.

Secondary Filter

It is recommended that secondary filter (fig. 6) be drained at same intervals as primary filter. Refer to "Primary Filter" in previous paragraph for intervals.

In addition to draining, the following check should be made at intervals of approximately 5,000 miles to determine the condition of the element. This check may be made by disconnecting outlet fuel line at filter and installing a pressure gauge connected to a "tee." Start engine and note pressure on gauge. If the pressure reading is less than 15 lbs. at 2,000 rpm, the element must be removed and replaced. Do not open the filter except at time of element replacement. Replacement usually will be required every 10,000 miles or 500 hours. DO NOT ATTEMPT TO CLEAN AND REINSTALL FILTER ELEMENT.

Replacing Secondary Filter Element

If periodic check, as described in previous paragraph, indicates filter element should be changed, proceed in same manner as described in paragraph under heading "Replacing Primary Filter."

SERVICING AIR CLEANERS AND AIR INTAKE SCREENS (Fig. 3)

Importance of keeping air cleaners in proper condition should be impressed on those responsible for mechanical upkeep of engine.

Unless air cleaners are cleaned periodically as service conditions require, they will not function properly, and in some instances, actually aggravate the condition which they are designed to prevent.

When air cleaner is loaded and dirty, and is used past its saturation point, some of this fine abrasive will get past cleaner and cause considerable damage to pistons, cylinder walls, and bearings.

For those reasons, air cleaners must be cleaned at regular intervals at least every 1,500 miles or more often if conditions warrant. Under adverse conditions or extensive operation on dusty or sandy roads, units should be cleaned every day or at least every 200 miles.

Air cleaners on vehicles operating in dust storm areas should be cleaned immediately after

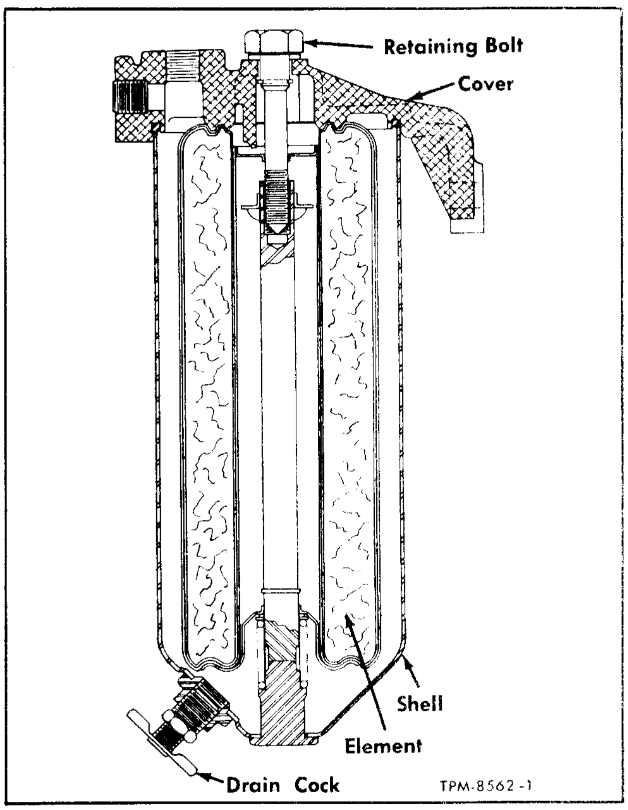


Figure 5—Sectional View of Primary Fuel Filter

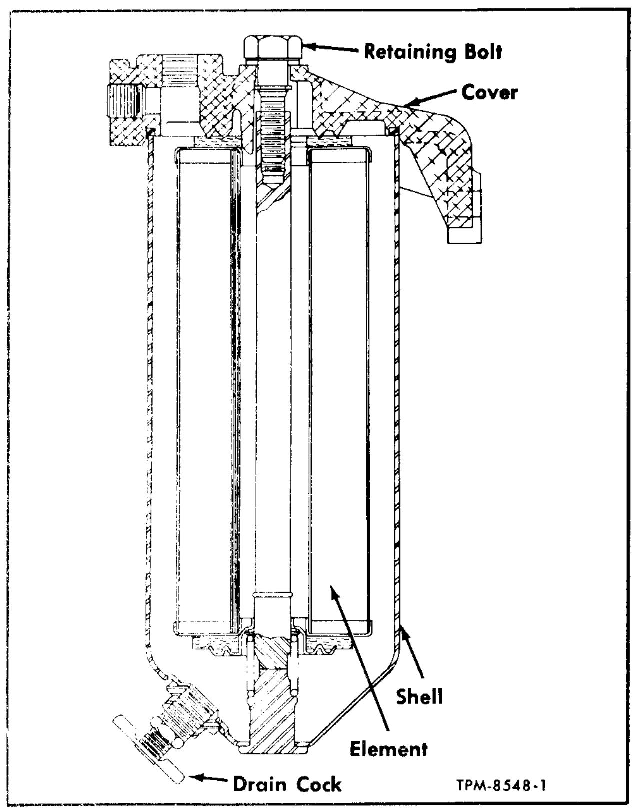


Figure 6—Sectional View of Secondary Fuel Filter

such storms occur.

Refer to LUBRICATION (SEC. 13) for instructions for servicing blower air cleaners.

Periodic inspection should be made at air intake openings to determine if screens have become clogged. An access plate attached by screws can be removed in engine compartment to permit use of air hose to clean right-hand screen from inner side. Screen in surge tank filler door can be cleaned readily with door opened.

ACCELERATOR CONTROLS

Lubrication and Inspection

Clevis pins and pivot points at accelerator control linkage must be lubricated periodically as instructed in LUBRICATION (SEC. 13). Cable and sliding ends are lubricated at time cable is installed and periodic lubrication is not required; however, the boots (10, fig. 2) should be inspected at regular inspection intervals. If cable requires replacement, lubricant as specified in LUBRICATION (SEC. 13) must be applied. Since correct adjustment of accelerator controls is necessary to prevent excessive strain on linkage, a periodic check should be made to assure proper adjustment as previously described under "Installation and Adjustment" in ACCELERATOR LINKAGE REPLACEMENT.

FUEL SYSTEM SPECIFICATIONS

FUEL FILTER	
Primary	
Make	AC
Model	T-67
Type	Replaceable Element
Element Model	T-552
Secondary	
Make	AC
Model	T-65
Type	Replaceable Element
Element Model	TP-540
AIR CLEANERS	
Number Used	4
Make	AC
Type	Oil Bath
Capacity	2 Qts. Ea.
FUEL TANK	
Capacity	140 gal.

Lubrication

USE OF CHART

The separate lubrication chart at back of this manual indicates location of points requiring periodic lubrication. This chart will serve the purpose of approximately locating various fittings and points of lubrication. When necessary, more detailed information on accessibility of lubrication points is described in following paragraphs.

INTERVALS

Intervals indicated on the chart are recommended for normal service. More frequent intervals may be used, if necessary, under severe operating conditions.

LUBRICANTS

Types of recommended lubricants are indicated on the chart by symbols. Descriptions of these lubricants are given in following paragraphs covering each type of lubricant. In the selection of the proper type of lubricants, the reliability of the oil supplier must be considered, as he must be responsible for the quality and performance of his product. The descriptions of the lubricants given will assist the coach operator to demand the correct quality and type.

MEANING OF LUBRICANT SYMBOLS

Symbol	Type of Lubricant
E	Engine Oil
SG	Steering Gear Lubricant
MP	Multi-Purpose Gear Lubricant
C	Chassis Lubricant
S2	High Temperature Grease
S3	Petroleum Jelly (Petrolatum)
S19	Type A Fluid
S20	Special Lubricant
S25	Air Conditioning Compressor Oil

METHODS OF LUBRICATION

Various methods of applying lubricant are described in paragraphs following:

Whenever cleaning, removal, or disassembly procedures are necessary to lubricate various units, such procedures are listed in applicable sections in the manual.

LUBRICATION AT ASSEMBLY

In addition to items shown on chart which are lubricated only at assembly. Refer to applicable section in manual for lubrication procedures on such items.

13

ENGINE OIL (SYMBOL "E" ON CHARTS)

TYPES OF OIL

Crankcase oils in service may oxidize, form sludge and varnish, and under some driving conditions, corrosive acids may accumulate in the crankcase. Heavy Duty engine oils minimize the formation of these harmful decomposition products and generally aid in obtaining extended trouble-free service.

The oil industry markets various types of engine oil under certain service designations, such as "ML," "MM," "MS," "DG," "DM," and "DS." Best quality heavy duty engine oils are designated as for service "DG," "DM," or "DS."

RECOMMENDATIONS

The responsibility for engine oil quality and performance - the application of the engine oil to the particular engine operating conditions - must remain with the engine oil supplier.

The selection of a reliable supplier, therefore with close attention to his oil and filter element change recommendations can provide satisfactory lubrication and longer life for your engine.

Supplement 1 heavy duty engine oils designed for service "DM" and which meet and exceed the requirements of MIL-L-2104A are recommended for use in Diesel engines.

Series 3 type engine oils (for service "DS") should be used only to overcome sludging conditions encountered with light load operation at temperatures of 0^{o}F. or below.

In some types of operation, multiviscosity engine oil may prove to be satisfactory. Application of this type of oil should be worked out with the supplier on his assurance of quality and satisfactory performance of his product in your engines.

LUBRICATION

Regardless of oil type used, suppliers should assure the following in furnishing oil for GM Diesel engines:

1. Good resistance to "scuffing" or excessive wear.
2. Good resistance to formation of high or low temperature deposits.
3. Good protection against rust and corrosion.
4. Good resistance to oxidation, thinning out in service, and excessive oil consumption.

"The use of proprietary blends of supplementary additives or concentrates such as engine oil supplements, break-in oils, tune-up compounds, friction reducing compounds, etc., is not recommended in lubricating oils of the Diesel engines in GMC Truck & Coach vehicles. A lubricating oil additive is available from GMC Dealers specifically for gasoline engines."

CHANGING OIL

It is recommended that engine crankcase oil be drained initially at 500 miles in order that possible oil contaminants are removed from engine as soon as possible after the engine is placed in service.

The intervals at which crankcase oil should be changed depend entirely upon the type and quality of oil used, the severity of vehicle operation, and the mechanical condition of the engine. Oil changing is closely related to filter element and air cleaner element changing. THE OIL MUST BE CHANGED OFTEN ENOUGH TO KEEP IT NON-ABRASIVE, NONCORROSIVE AND REASONABLY CLEAN. It is imperative that regular intervals be established and crankcase oil and oil filter element be changed regularly.

Crankcase should be drained only after a run or when oil is hot, for best results.

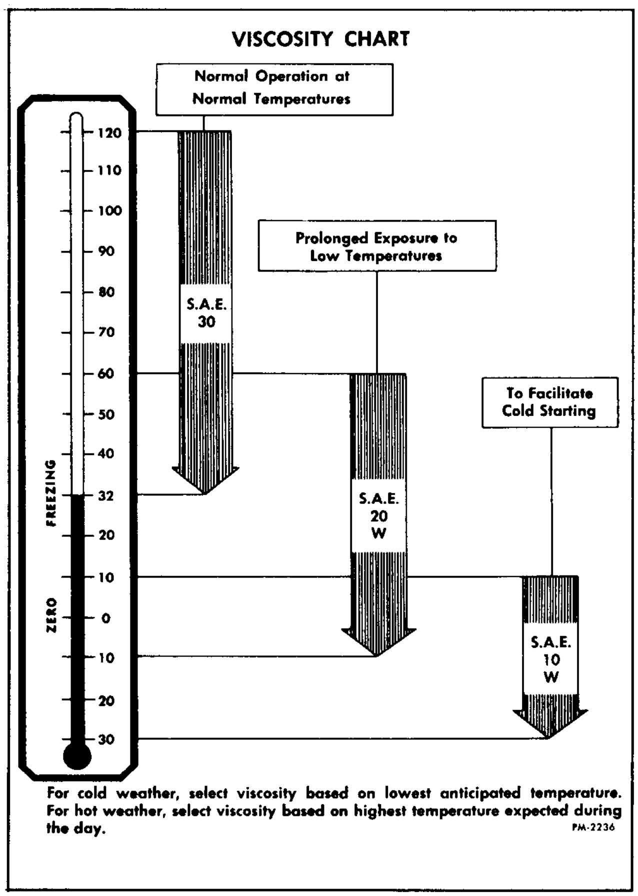


Figure 1—Engine Oil Viscosity Chart

OIL CHANGE PERIODS

In general service, with fuel conforming to GMC recommendations, and using oil of MIL-L-2104A Supplement 1 A.P.I. Service Classification "DM," - drain crankcase every 4,000 miles or 30 days, whichever occurs first (see Note 1).

If Series 3 oil is used, oil change period should be on oil suppliers recommendation (see Note 1).

Note 1

Use of independent laboratory oil analysis reports, or oil supplier recommendation, should be made to determine if more or less frequent oil and filter element change periods are required, or possible.

VISCOSITIES

Atmospheric temperatures and severity of service determine the viscosity grade of engine oil to use. Viscosity numbers constitute a classification of lubricants in terms of viscosity or fluidity, with no reference to any other characteristics or properties.

As a guide to the selection of the proper grade or viscosity of oil to be used at various atmospheric temperatures, refer to "Viscosity Chart" shown in figure 1. If cold starting is a problem, use of lighter oil will lessen starting difficulties.

CHECKING LEVEL

Daily, or oftener if necessary, check oil level. Make the check preferably after a day's run and after engine has been stopped for a few minutes. Remove dipstick, wipe clean with cloth, reinsert and remove again. The upper mark on engine oil dipstick is "FULL," the lower "ADD." Keep level as close as possible to "FULL" mark without overfilling. Do not operate with level below "ADD" mark.

TRANSMISSION

Transmission lubricant should be Heavy Duty engine oil of the same type as used in engine.

VISCOSITY

During summer (Above 32°F.) use S.A.E. 30 or S.A.E. 20 during winter (Below 32°F.).

CHECKING LEVEL

Transmission oil level dipstick is marked "COLD" "LEVEL" and "HOT." The dipstick is accessible after engine compartment right side door is opened.

Oil level should be checked immediately after a run when the oil in transmission is hot. The oil level should then be at "HOT" mark on dipstick. If level is checked after transmission has cooled, such as overnight, the oil level should be at "COLD" mark on dipstick.

DRAINING

Drain after first 3,000 miles of operation and thereafter at recommended intervals.

Transmission should be drained while unit is warm, preferably immediately after a run. Drain plug is located in the transmission case sump and is accessible under the engine compartment after compartment bottom pan is dropped. Remove plug to completely drain the unit. Plug is magnetic type, and should be thoroughly cleaned before reinstalling.

FILLING

After transmission is thoroughly drained, fill through top filler plug hole. The capacity of transmission is approximately 21 pints. Check level at dipstick a few minutes after transmission is filled. Level should be brought to "COLD" mark on dipstick.

OTHER ENGINE OIL USES

BLOWER AIR CLEANERS

Blower air cleaners, accessible after engine compartment door is raised, should be serviced at intervals recommended on chart. If service conditions warrant, cleaning and servicing intervals should be more frequent.

1. Release two latches near bottom, then pull reservoir downward.
2. Lift oil baffle from reservoir, then pour oil from reservoir. Clean reservoir and baffle in cleaning fluid to remove all accumulated deposits.
3. Pull element downward and out of cleaner body. Slush element up and down in bath of cleaning fluid, until all oil and dirt deposits are removed. Permit element to dry thoroughly, but do not use compressed air.

Figure 2—Oil Level in Air Cleaner Reservoir

4. Whenever inspection indicates that space between body and liner is restricted, liner should be removed and cleaned.
5. Reinstall element in body liner, being sure that element is pushed up as far as possible.
6. Fill reservoir up to "OIL LEVEL" mark on bracket at center of reservoir (fig. 2) using same grade of oil as used in engine. Install oil baffle at center of reservoir.
7. Install reservoir to cleaner body, then secure with two latches.

OIL FILTER

Engine oil filter is mounted near front of engine and is a "Full-Flow" type.

Element changing periods are closely related to crankcase oil changing periods, the quality of oil used, and the type of operation.

ELEMENT REPLACEMENT

1. Remove drain plug from filter housing and drain oil from filter.
2. Loosen filter housing bolt, then remove bolt from housing. Remove element from housing.

3. Wipe out housing thoroughly. Check gasket surface at top of housing for dirt and burrs which might cause air leaks.

4. Install new element in housing. Install housing on filter base with filter drain plug away from engine.

5. Run engine for a few minutes. Check filter for leaks; then check dipstick level. Add oil to bring up to (not above) "FULL" mark on dipstick.

CLUTCH AND AIR CONDITIONING AIR CYLINDER

Air cylinder is equipped with a square lead pipe plug at end. At recommended intervals, remove plug and apply one ounce of S.A.E. 10 engine oil.

CLUTCH CONTROL VALVE

Clutch control valve is equipped with a ball oiler and air filter. At recommended intervals apply oil through oiler, also remove, clean, and reinstall filter.

STARTER

Starter is equipped with plugs at commutator, center bearing, and drive ends. At specified intervals, remove plugs and apply lubricant.

CONTROL ROD LINKAGE

All control rod linkage pins and joints should be oiled regularly with light engine oil. Use can or spray.

MULTI-PURPOSE GEAR LUBRICANT (SYMBOL "MP" ON CHART)

Multi-purpose gear lubricant must satisfactorily lubricate heavy duty coach axles under maximum torque and speed conditions. It must provide necessary and suitable load-carrying characteristics to prevent scoring and wear, good stability in storage and service, and give good resistance to corrosion. Suppliers should assure these characteristics and be responsible for the quality and satisfactory performance of their product. Many oil companies can supply lubricant, conforming with above description, under the requirements of Military Specification MIL-L-2105B or Timken Specification 0-65 (0-64 for cold weather).

REAR AXLE

Checking Level

At intervals indicated on chart, remove filler plug in differential cover. Add sufficient lubricant to bring level up to filler plug opening. Install and tighten plug. Check level after a run or while differential is warm.

Viscosity

S.A.E. 140 should be used the year around, except in cases of extremely low temperatures. If vehicle is parked in temperatures below $+20^{\circ}$F., or operated in temperatures consistently below 0°F., it is advisable to use S.A.E. 90.

Draining and Filling

When axle is new, or after overhaul, it is recommended that lubricant be drained after first 3,000 miles of operation, and thereafter at recommended intervals. Draining at an early mileage removes fine particles of metal or other foreign material.

At recommended intervals, remove plug at bottom of housing to drain lubricant. Drain when unit is hot, preferably immediately after operation. Reinstall and tighten drain plug.

Fill axle to level of filler plug in housing cover. Install and tighten level plug. Capacity of rear axle is indicated on chart.

GEAR OIL (SYMBOL "G" ON CHART)

Type of lubricant indicated by the symbol "G" on chart must be a straight mineral gear oil of the best quality. Oxidation inhibitors or anti-foam agents may be added to these oils to gain greater stability and resistance to thickening.

UNIVERSAL JOINTS

At recommended intervals, use pressure gun to apply lubricant through fitting in universal joint trunnion. Apply until lubricant is forced out around trunnion seats. Use S.A.E. 140 the year around.

STEERING GEAR LUBRICANT (SYMBOL "SG" ON CHART)

The lubricant indicated by the symbol "SG" is a special steering gear lubricant, No. 0 grade with low cold test characteristics and extreme pressure properties. This type of lubricant is marketed by many oil companies. In the event that low cold test extreme pressure lubricant meeting the above specifications cannot be obtained, use #1 Multi-Purpose (lithium base) grease. Multi-Purpose "MP" lubricant may be used for make-up only.

STEERING COLUMN BEVEL GEAR HOUSING
Steering column bevel gear housing is accessible through door at left front corner of coach. Clean breather at top of housing. Fill housing through fitting at bottom of housing, until lubricant is level with breather.

STEERING GEAR HOUSING
Steering gear housing is located on top of front axle. Clean breather in housing. Fill housing through fitting at bottom of housing, until lubricant is level with breather.

SPEEDOMETER AND TACHOGRAPH CABLE
Remove inside cable from cable housing. Coat lightly with lubricant and avoid excessive amount.

CHASSIS LUBRICANT (SYMBOL "C" ON CHART)

Chassis lubricant should be a high grade calcium, lithium, or aluminum soap pressure gun lubricant. Sodium soap grease may be used as chassis lubricant, but more frequent application may be required during wet weather. This lubricant should be used at all points indicated by the symbol "C" on chart.

Good quality multi-purpose lithium soap grease is recommended, especially for extreme operating conditions - water, heat, etc.

All pressure gun lubrication fittings must be clean before applying gun. Apply sufficient lubricant to thoroughly lubricate entire bearing or bushing.

LOCATION OF POINTS

The chart at back of book shows relative location of chassis lubrication points. Locations described in following paragraphs, however, will assist in readily locating these points.

UNDER VEHICLE (FRONT)
- Steering Knuckles
- Steering Tie Rod Ends
- Steering Drag Link Ends
- Steering Prop. Shaft U-Joints
- Steering Prop. Shaft Slip Joint
- Front Slack Adjusters
- Front Brake Camshafts
- Transmission Control Tower

UNDER VEHICLE (REAR)
- Rear Slack Adjusters
- Rear Brake Camshafts
- Prop. Shaft U-Joints
- Prop. Shaft Slip Joint
- Hand Brake Camshaft
- Hand Brake Relay Levers
- Hand Brake Bell Crank
- Air Cond. Compressor U-Joints
- Air Cond. Compressor Slip Joint

ENGINE COMPARTMENT
- Speedometer Adapter (Wheel Used)
- Transmission Control Levers
- Clutch Release Shaft
- Control Rod Bell Cranks

FRONT DOOR HINGE
Lower hinge fitting is accessible at underside of coach.

INSIDE COACH
- Destination Sign Gears
- Front door upper hinge is accessible through safety equipment door opening.

TOOL COMPARTMENT
- Clutch Pedal
- Clutch Control Cross Shaft
- Steering Prop. Shaft Support Bearing
- Steering Prop. Shaft U-Joints
- Steering Prop. Shaft Slip Joint

HIGH TEMPERATURE GREASE (SYMBOL "S2" ON CHART)

The type of lubricant indicated by symbol "S2" on chart, should be a short fiber, #2 sodium soap grease having a high melting point ($300^{\circ}F.$, min. melting point).

WHEEL BEARINGS

Instructions for the removal, installation, and adjustment of wheel bearings will be found in "HUBS AND BEARINGS" (SEC. 19).

Cleaning

With a stiff bristle brush and cleaning solvent, thoroughly clean bearings and hubs, making sure that all old lubricant and dirt is removed. Check bearings and cups and replace damaged parts.

Packing

When packing by hand, be sure that lubricant is kneaded between rollers and races. A mechanical lubricator can be used; however, bearings must be thoroughly lubricated.

DO NOT FILL HUB. Coat inside of hub and axle spindle with thin coat (1/8" thick) of grease to retard rusting. Allow some excess grease at open end of bearings and around adjusting nut. DO NOT PACK HUB WITH GREASE. The lubricant in bearings is sufficient to provide adequate lubrication until next service period. Readjust bearings as described in "HUBS AND BEARINGS" (SEC. 19).

CAUTION: Do not use lubrication fittings on hubs. Lubricant must not be forced into hubs.

CLUTCH RELEASE BEARING

Clutch release bearing is lubricated from a grease cup. At recommended intervals, turn cup down one full turn. Refill cup when empty.

AIR CONDITIONING COMPRESSOR CLUTCH SHAFT

Compressor clutch shaft bearing is lubricated through a grease fitting. At recommended intervals, apply lubricant sparingly from a hand gun. Excessive lubricant may reach clutch facings.

PETROLEUM JELLY (SYMBOL "S3" ON CHART)

The type of lubricant, indicated by symbol "S3" is petroleum jelly or petrolatum.

BATTERY TERMINALS

Keep battery terminals clean. At regular intervals, remove cables; then clean terminals on cables and batteries. Apply petroleum jelly after tightening terminals to prevent corrosion.

TYPE A FLUID (SYMBOL "S19" ON CHART)

Fluid indicated by symbol "S19" on chart, must be an "Automatic Transmission Fluid - Type A" supplied in containers bearing mark "AQ-ATF," followed by an identification number and letter "A." DO NOT USE ANY OTHER FLUID.

POWER STEERING SYSTEM

The supply tank for power steering system is mounted with the system pump on engine timing gear housing. The level of fluid in the tank should be checked at intervals indicated on chart.

To replenish tank to "FULL" mark on dipstick remove wing nut in cover. After thoroughly cleaning around cover, remove cover. The fluid should be poured through a 200-mesh screen which may be placed or soldered in the large end of a funnel. Before using funnel, make certain that it is clean. Do not use a cloth strainer when filling or adding fluid to system. Cloth strainers contain lint which is harmful to the system. Install cover securely.

BLEEDING POWER STEERING SYSTEM

Whenever a line is disconnected or a pump is replaced, the air that has entered the hydraulic system must be bled out, otherwise noisy and unsatisfactory operation will result.

1. Fill oil reservoir and let oil remain undisturbed for about two minutes.
2. Raise front end of vehicle so that wheels are off the ground.
3. Turn the wheels to right and left to the wheel stops to eliminate air pockets in power cylinder. Continue this operation until fluid in reservoir stops bubbling. Replenish fluid in reservoir during this operation.
4. Start the engine and run at idle for two

minutes. Turn wheels right and left as before. DO NOT HIT WHEEL STOPS. Recheck fluid level, and hoses and connections for leaks. Continue this operation until oil is clear of bubbles.

5. Increase engine speed to approximately two-thirds of full throttle and continue to run at this speed until all signs of bubbles disappear from oil in reservoir as wheels are turned from right to left. DO NOT HIT STOPS.

6. Lower the vehicle and turn the wheels on the ground. Recheck system for leaks. Check fluid in reservoir and refill to "FULL" mark on dipstick as previously directed.

DO NOT USE HYDRAULIC BRAKE FLUID OR SHOCK ABSORBER FLUID. CARE SHOULD BE TAKEN TO KEEP THE FLUID CLEAN AND FREE OF WATER.

AIR CONDITIONING CONDENSER FAN DRIVE

Refer to "AIR CONDITIONING" (SEC. 26) for method of draining, filling, and replenishing fluid in system.

SPECIAL LUBRICANT (SYMBOL "S20" ON CHART)

Lubricant to be used on accelerator control cables is available through AC Spark Plug Distributors as "Type ST-640." Refer to FUEL SYSTEM (SEC. 12) for control cable lubricating procedures.

AIR CONDITIONING COMPRESSOR OIL (SYMBOL "S25" ON CHART)

This fluid is a special wax-free, non-foaming, dehydrated type of oil, having a viscosity of about S.A.E. 10. This oil is available from many major oil companies under various trade names.

Refer to "AIR CONDITIONING" (SEC. 26) for method of checking, adding, and recharging an empty system.

SPECIAL MULTI-PURPOSE GREASE (SYMBOL "S26" ON CHART)

Lubricant indicated by symbol "S26" should be a Lithium Base #2 Grease with 3% Molybdenum Disulfide, commonly called "Multi-Purpose Grease No. 2 With 3% Moly."

Whenever accessible air conditioning compressor main bearing carrier should be hand packed as described in AIR CONDITIONING (SEC. 26) of this manual.

LUBRICANTS MUST BE STORED AND DISPENSED IN SUCH A MANNER THAT THEY WILL BE CLEAN AND FREE OF CONTAMINATION, DUE TO DIRT OR OTHER FOREIGN MATTER.

Air Suspension

Information in this section covers complete description, operation, and maintenance of the air suspension system. Replacement of the various air suspension components is also covered. Since replacement of the front and the rear axle consists primarily of disconnecting and connecting the air suspension components, these procedures are also included in this section.

SYSTEM DESCRIPTION

The air suspension system, for the most part, is made up of suspension supports, air bellows, height control valves, radius rods, and shock absorbers. The supports provide the means by which the suspension system is connected to the axles. The system operates automatically and maintains a constant ride height regardless of load or of load distribution.

Vertical loads are supported by eight rubberized nylon fabric air bellows assemblies (fig. 2). Four 8" bellows are used at front axle and four 10" bellows are used at rear axle. Bellows are installed between beams in coach body structure and suspension supports attached to axles as shown in figure 1. Upper bead of bellows is clamped between upper retainer and mounting surface. Lower bead is clamped between lower retainer and piston. When bellows assembly is installed, beads form air-tight seals.

The pressure in air bellows is varied automatically in proportion to vehicle load by height control valves. Three height control valves, one at front axle and two at rear axle, maintain constant vehicle height for all load conditions. Height control valve levers are connected to axles by links.

Radius rods, four at each axle, transmit driving and braking forces from axles to the coach body. These rods also control the lateral and longitudinal position of each axle under the vehicle. Each end of radius rods contains a rubber bushing that requires no lubrication. Telescoping type double-acting shock absorbers are mounted at ends of each axle. Stabilizer bar, attached in rubber mountings to body, is linked at both ends to rear suspension supports.

Suspension supports at front axle and at rear axle are welded steel assemblies. Suspension supports include bellows lower mountings. Four mounting studs are welded on front support, also radius rod brackets are welded to left support. Rear suspension support includes mounting brackets for lower radius rods, shock absorber, bellows, stabilizer bar link, and brake chamber. Suspension support is bolted to axle bracket.

SYSTEM OPERATION

Compressed air from the suspension air tank is supplied to height control valves. Pressure regulator valve, however, allows removal of air from main tank only when pressure is above 65 psi. A check valve at suspension tank prevents loss of air back into main system. An air filter is connected in line at pressure regulator valve. Height control valves, one at front axle and two at rear axle, meter air into the bellows as needed. Valves are actuated by the relative movement between body and axles.

Loading. As coach is loading, the body settles toward axles. This movement operates height control valves and valves meter air into bellows. Air pressure in bellows increases sufficiently to compensate for the additional load. This keeps the coach body at normal ride height.

Unloading. As the coach is unloading, the height control valves exhaust air from the bellows. Valves reduce air pressure in proportion to the decrease in weight, again keeping the coach body at normal ride height.

The height control valves are designed to operate only when load on coach is increased or decreased. Valves do not respond to rapid relative motion between axles and body such as that caused by road bumps. Refer to "Height Control Valves" later in this section for a detailed description of height control valve operation.

SYSTEM MAINTENANCE

Air suspension system requires no lubrication, and with the exception of the inspection and test

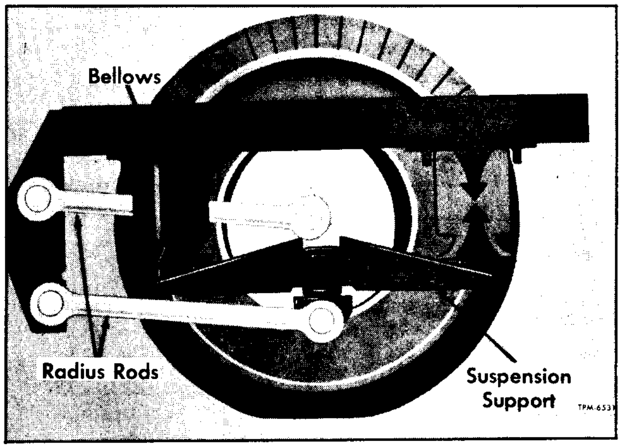


Figure 1—Sketch of Air Suspension System

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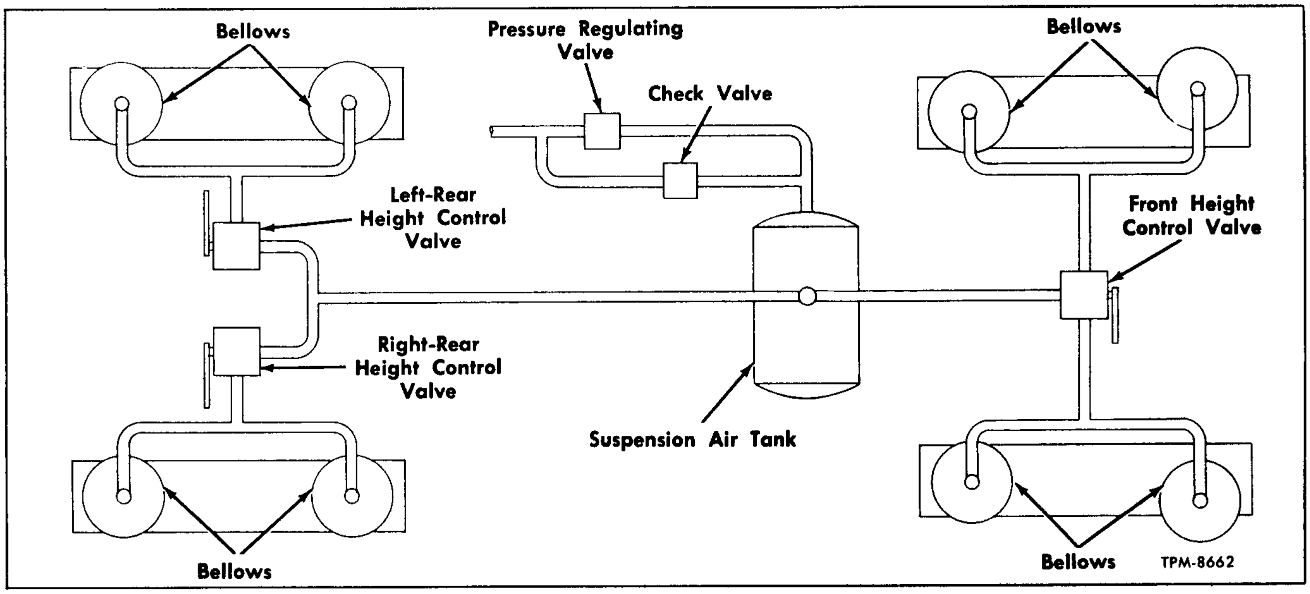


Figure 2—Schematic Diagram of Air Suspension System

procedures outlined below, requires very little maintenance. By accomplishing these inspection and test procedures at established chassis inspection periods, sub-standard performance may be revealed before the condition becomes bad enough to cause operator complaints or failure on a run. Diagram of the suspension air system is shown in figure 2.

CAUTIONS

1. Do not attempt to work under vehicle without first blocking body or placing vehicle over a pit. With air bellows deflated, there is not sufficient clearance under vehicle for a man on a creeper. When blocking body, place blocks under engine cradle forward mounting brackets, also at front end of front axle forward radius rods.

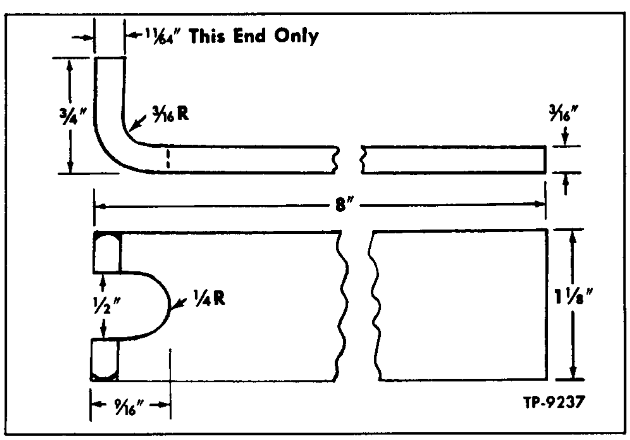


Figure 3—Special Tool For Drain Cock

2. Use no lubricant, not even water, on radius rod rubber bushings.

3. If necessary to tow vehicle with one end raised, axle must be chained to body. This is necessary since air pressure will be exhausted from bellows at the raised end. The weight of the axle hanging on the deflated bellows may damage bellows or shock absorbers. Chains can be secured around axle and through the axle bumper brackets.

AIR TANKS

Suspension air tank, as well as the main air tanks, must be drained daily to keep air system as free of moisture as possible. In cases of extreme cold weather, an alcohol evaporator should be installed to introduce alcohol vapor into the air system to prevent moisture from freezing. Drain cock at bottom of tank is recessed-key type. A special tool or a large L-shaped screwdriver must be used to open and close drain cock. The special tool can be made locally. Dimensions for making tool are shown in figure 3.

AIR LEAKAGE TEST

With the main air system at normal operating pressure (100-120 psi), coat all suspension air line connections and bellows mountings with soap and water solution. Air leakage will produce soap bubbles. No leakage is permissible. Leakage at air line connections can sometimes be stopped by tightening the connection. Where air line connections having rubber sleeves are used, replace rubber sleeve. If tightening mounting nuts does not stop leakage, remove and inspect bellows. Replace bellows, if necessary.

MOUNTING AND BELLOWS INSPECTION

Make a wrench check for loose suspension support stud and mounting bolt nuts, radius rod anchor bolts and nuts, shock absorber mountings, and height control valve mountings. Suspension support, radius rod, and shock absorber mountings must be tightened to torque listed in "Specifications" at end of this section. Visually inspect all bellows for cracks, abrasions, or other damage which might develop into a rupture. Replace with new bellows if any damage is evident. Piston surface should be smooth and free from cracks.

RIDE HEIGHT CHECK AND ADJUSTMENT

Normal system minimum pressure is 105 psi and maximum pressure is 115-120 psi. At this pressure, height control valves will automatically meter air into or out of bellows as load changes.

Normal Ride Height

Ride height measurements are taken between axle bumpers and top of axle housing as shown in figure 4.

NOTE: Normal ride height clearance dimensions given are based on the thickness of new axle bumpers (fig. 4). If coach is left standing for extended periods without air pressure in the air suspension system, the weight of the body on the axle bumpers may cause the bumpers to take permanent set in a flattened condition. Original thickness of new bumpers is shown in figure 4. If bumpers are flattened to less than the dimension shown, an equal amount should be added to the clearance specified to maintain normal ride height.

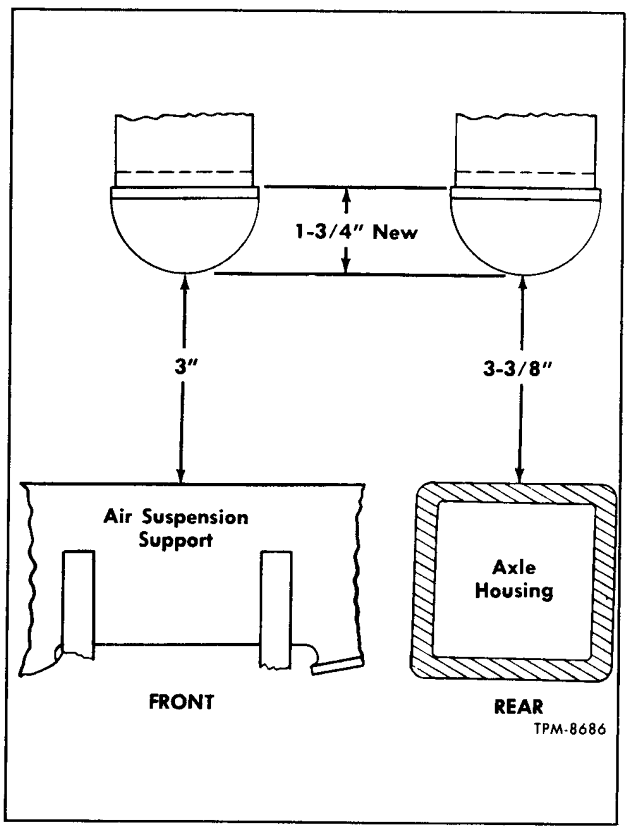


Figure 4—Normal Ride Height Clearance

Overtravel Lever Adjustment

Change position of valve lever on overtravel assembly, if necessary, to obtain the above dimensions. Position of the lever may be changed by loosening nut (fig. 5) on adjusting bolt. Intake and exhaust valves of height control valve can then be operated independently of linkage.

Height control valve lever will move 3/16 inch up or down from neutral position (free travel) without causing any valve action. If amount of adjustment required falls within these limits, adjust lever the required amount. However, body will not raise or lower until load is increased or decreased to actuate height control valve.

If any one of the height control valve does not function properly with the lever correctly adjusted, check for restricted air lines. If valve still does not hold body at normal ride height with lever properly adjusted, and with no restriction in air line, valve should be removed and overhauled or replaced with a new or rebuilt unit. Refer to "Height Control Valve Overhaul" later in this section.

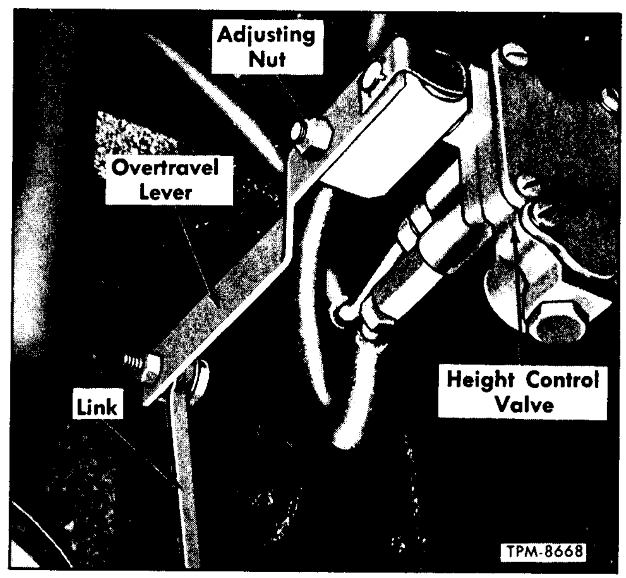


Figure 5—Valve Overtravel Lever Adjustment

AIR SUSPENSION

FRONT AXLE AND FRONT SUSPENSION REMOVAL

The procedures which follow cover removal of front axle assembly and suspension components. Procedures also cover removal of suspension components from axle assembly. Method used to support axle and suspension units during removal and disassembly depends upon local conditions and available equipment. Front axle and air suspension components are shown in figure 6.

REMOVAL PROCEDURE

1. Block rear wheels to prevent coach from rolling. Position a hydraulic floor jack near outer end of front axle beam.

CAUTION: Blocks or special adapters should be used on jack lifts in a manner which will prevent axle from rolling off jacks when disconnected.

2. Raise front end of vehicle with jacks until bottom of body is approximately 18" from floor. Block body in raised position. Place each block under bracket at forward end of radius rods.

IMPORTANT: Do not raise body with hoist or chain fall and permit axle to hang unsupported. The weight of the hanging axle may damage the bellows.

3. Lower jacks until body rests on blocks, but with jacks still supporting axle. Remove wheels and tires. Carefully swing ends of jacks out from under vehicle to provide free working area.
4. Exhaust compressed air from air supply system by opening drain cock in suspension air tank.
5. Disconnect steering gear drive shaft rear universal joint from steering gear.
6. Disconnect hoses from brake chambers, and air lines from bellows.
7. Disconnect height control valve link from bracket attached to steering gear support. Pull down on height control valve lever to exhaust compressed air from bellows.
8. Disconnect both ends of lower radius rods and upper and lateral radius rods. Refer to "Radius Rods" later in this section.
9. Remove nut from stud attaching bellows lower retainer at each end of two supports.

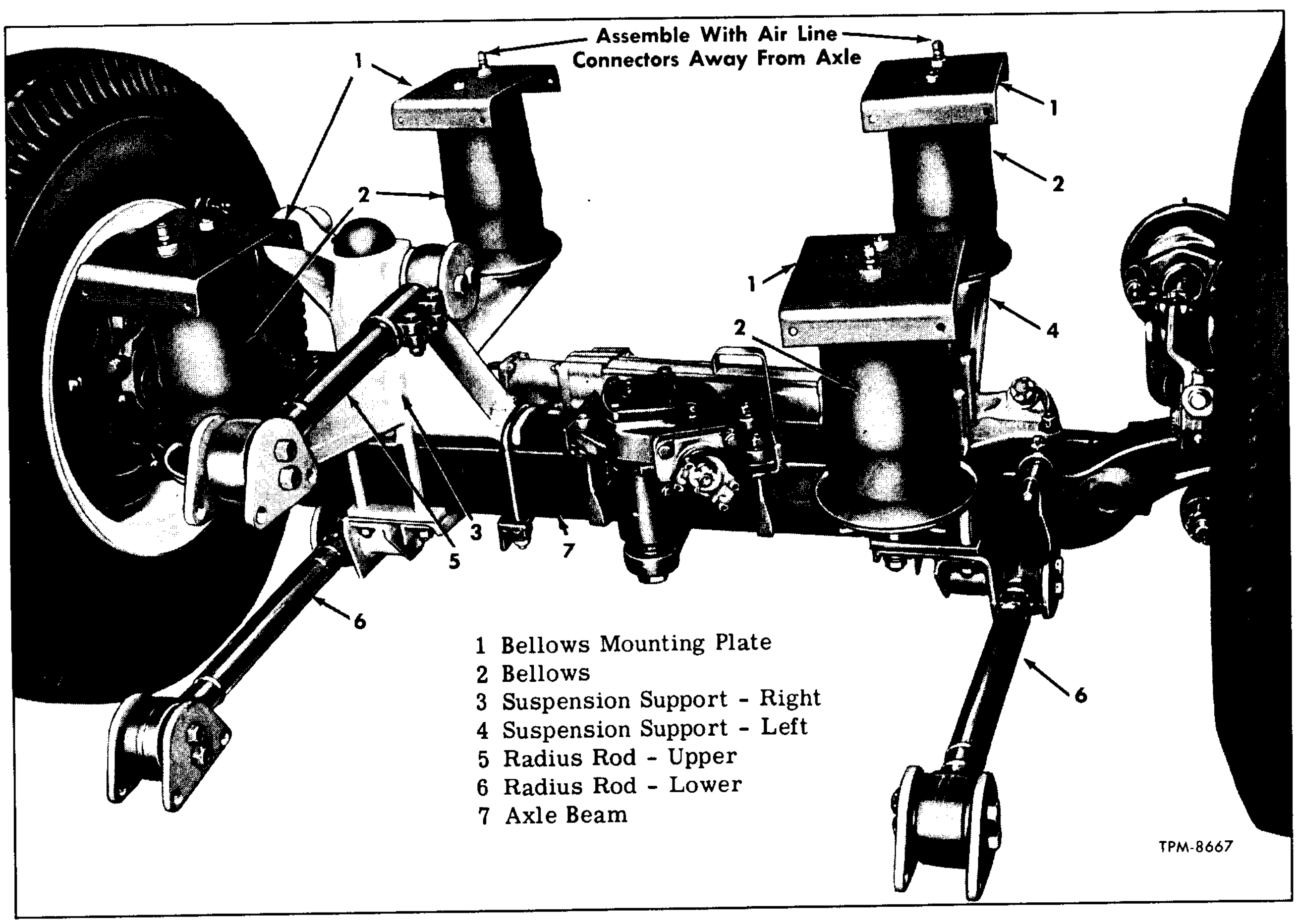


Figure 6—Front Axle and Air Suspension Units

10. Remove shock absorbers as directed in "Shock Absorbers" later in this section.

11. Lower axle on jacks until bellows lower retainer is clear of support and axle will clear underside of coach. Carefully pull jacks and axle assembly from under coach.

12. If desired, remove air bellows as directed in this section under heading "Air Bellows."

REMOVAL OF SUSPENSION COMPONENTS

1. Support axle in such a position so that suspension support stud nuts are accessible, then remove nuts. Lift suspension support off top of axle.

2. Remove nuts from two U-bolts attaching shock absorber brackets to axle. Remove U-bolts and bracket.

3. Remove nuts from U-bolt attaching right suspension to axle beam. Lift suspension support from axle.

FRONT AXLE AND FRONT SUSPENSION INSTALLATION

Assemble suspension units to axle as illustrated in figure 6, before moving axle under coach. The method used to support axle and suspension supports is dependent upon local conditions and available equipment.

1. Install each suspension support on axle with hole in support over locating pin in axle. Supports are not interchangeable.

2. Install brackets under axle beam and over support studs. Bracket should fit over locating pin and with radius rod anchor pin toward outside. Install washers and nuts and tighten to torque listed in "Specifications" at end of this secton.

3. Place upper radius rod in position over locating pin on axle. Lateral radius rod anchor pin on support will be at rear of axle and on right side.

INSTALLATION PROCEDURE

1. Bellows assemblies should be installed before axle is moved back under coach. Refer to bellows replacement in this section for installation procedure.

2. Position axle on two hydraulic floor jacks, with one jack lift under each lower radius rod axle bracket.

CAUTION: Blocks or special adapters should be used on jack lifts to prevent axle from falling off jacks.

3. Carefully move axle into position under coach. Lift axle and align bellows lower retainer bolt with support plate. Install bolt nut, and washer then tighten.

4. Connect upper radius rod and lateral radius rod to anchor brackets. Refer to "Radius Rods" later in this section. Do not tighten cap screws or mounting bolt nut.

5. Install lower radius rods. Refer to "Radius Rods" later in this section. Do not tighten cap screws or mounting bolt nuts.

6. Install shock absorbers as directed under "Shock Absorbers" later in this section.

7. Position each end of axle by raising or lowering jacks to provide a clearance of 3" (normal ride height) between axle bumper and contact surface on suspension support (fig. 4). Refer to "Normal Ride Height" in "Ride Height Check and Adjustment" earlier in this section. With axle in normal ride height position, tighten radius rod cap screws and anchor bolt lock nuts to torque listed in "Specifications" at end of this section. Thread lock wire through cap screws and twist ends of wire together.

8. With axle still in normal ride height position (step 7 above), connect height control valve link to height control valve.

9. Connect steering gear drive shaft to steering gear on axle.

10. Connect flexible hoses to each brake chamber. Make sure connections are tight. Connect air lines to bellows. Replace rubber sleeves if deteriorated or damaged.

11. Swing jacks under vehicle to permit installation of wheels. Install wheels.

12. Raise coach and remove blocks from under body. Lower vehicle to floor and remove jacks. Build up air pressure in system to normal operating pressure. Wait a few minutes for air to flow into suspension system, then check clearance between axle bumpers and suspension supports (fig. 4). If clearance is appreciably more or less than 3", adjust overtravel lever on height control valve as necessary to obtain this dimension. Refer to "Ride Height Check and Adjustment" earlier in this section. Make sure lever adjusting screw is tight when adjustment is completed.

13. Check for air leakage at all bellows upper and lower mountings. Coat mountings with soap and water solution and watch for appearance of soap bubbles. No leakage is permissible. If leakage is evident, bellows must be disconnected and mating surfaces must be cleaned. Bellows must be replaced if bead is damaged.

REAR AXLE AND REAR SUSPENSION REMOVAL

The procedures which follow cover removal of rear axle assembly and suspension components. Procedures also cover removal of suspension components from axle assembly. Method used to support axle and suspension units during removal and disassembly depends upon local conditions and available equipment. Rear axle and air suspension units are shown in figure 7.

AIR SUSPENSION

REMOVAL PROCEDURE

1. Block front wheels to prevent coach from rolling. Position a hydraulic floor jack under center of each suspension support.

CAUTION: Jack lifts should be equipped with large bowls, or similar precautions should be taken to prevent axle from rolling off jacks when disconnected.

2. Raise rear end of vehicle with jacks until bottom of body is approximately 18" from floor. Block body in raised position. Make sure blocks are placed under engine cradle forward mounting brackets.

IMPORTANT: Do not raise body with hoist or chain fall and permit axle to hang unsupported. The weight of the axle will damage the bellows.

3. Lower jacks until body rests on blocks, but with jacks still supporting axle. Remove wheels and tires. Carefully swing jacks out from under vehicle to provide free working area.

4. Exhaust compressed air from air supply system by opening drain cock in suspension air tank.

5. Disconnect propeller shaft and parking brake control rod from axle.

6. Disconnect flexible hoses from brake chambers, and air lines from bellows.

7. Disconnect height control valve links from overtravel levers. Pull down on each height control valve lever to exhaust compressed air from bellows.

8. Disconnect stabilizer bar. Refer to "Stabilizer Bar" later in this section.

9. Remove lower, upper, and lateral radius

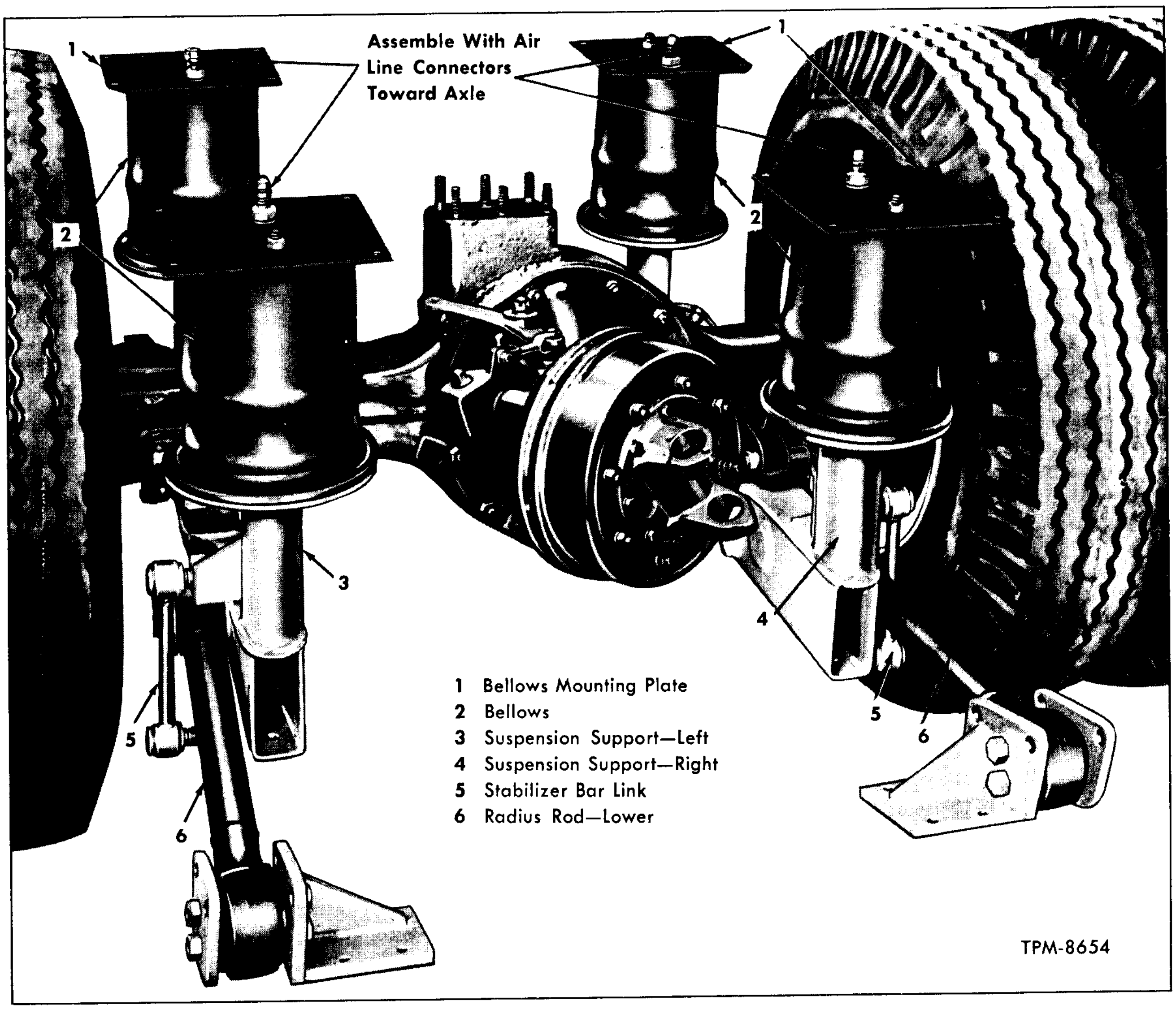


Figure 7—Rear Axle and Air Suspension Units

rods. Refer to "Radius Rods" later in this section.

10. Remove nuts and washers attaching each bellows lower retainer to support plate.

11. Remove shock absorbers as directed under "Shock Absorbers" later in this section.

12. Lower axle on jacks until assembly will clear underside of vehicle. Carefully pull jacks and axle assembly from under vehicle.

13. If desired, remove bellows as directed in this section under heading "Air Bellows."

REMOVAL OF SUSPENSION SUPPORTS

1. Support axle assembly so that suspension supports may be removed safely from axle.

2. Remove brake chambers and stabilizer bar links from suspension supports.

3. Remove four nuts, spacers, and bolts attaching each suspension support to axle housing. Remove suspension support.

REAR AXLE AND REAR SUSPENSION INSTALLATION

ASSEMBLY OF AXLE AND SUSPENSION SUPPORTS

Assemble suspension units to axle before moving axle under coach as illustrated in figure 7. Radius rods, however, should be installed after axle is in position. The method used to support axle and suspension supports is dependent upon local conditions and available equipment. Tighten all studs, bolts, and nuts to torque listed in "Specifications" at end of this section.

1. Position each suspension support under axle. Radius rod and shock absorber anchor pins on supports should be on the parking brake side of the axle. Attach support to axle with four bolts, spacers, and nuts. Tighten nuts to torque listed in "Specifications" at end of this section.

2. Attach brake chambers and stabilizer bar links.

INSTALLATION PROCEDURE

1. Bellows assemblies should be installed before axle is moved under coach. Refer to bellows replacement under "Air Bellows" heading in this section for installation procedure.

2. Center a hydraulic floor jack under each suspension support.

CAUTION: Jack lifts should be equipped with large bowls, or similar precautions should be taken to prevent axle from rolling off jacks when disconnected.

3. Carefully move jacks and axle assembly into position under coach. Lift axle and align plate on each bellows assembly with plate on beams. Attach each bellows to plate with two nuts. Tighten nuts to torque listed in "Specifications" at end of this section.

4. Install shock absorbers as directed under "Shock Absorbers" later in this section.

5. Connect lateral, upper, and lower radius rods. Refer to "Radius Rods" later in this section. Do not tighten cap screws or lock nuts.

6. Raise or lower jacks to provide an axle clearance of 3-3/8" (normal ride height) between rubber axle bumpers and axle as shown in figure 4. Refer to "NOTE" under "Height Control Valves" in "System Maintenance" earlier in this section. With axle in normal ride height position, tighten radius rod cap screws and anchor bolt lock nuts to torque listed in "Specifications" at end of this section. Thread lock wire through cap screws and twist ends of wire together.

7. With axle still in normal ride height position (step 6 above), connect height control valve links to valves.

8. Connect propeller shaft and parking brake linkage to axle.

9. Connect flexible hose to brake chambers. Make sure connections are tight. Connect air lines to bellows. Replace rubber sleeves if deteriorated or damaged.

10. Install stabilizer bar and links as directed under "Stabilizer Bar" later in this section.

11. Swing jack out of the way under coach and install wheels and tires.

12. Raise coach with jacks and remove blocks from under body. Lower vehicle to floor and remove jacks. Build up air pressure in system to normal operating pressure. Wait a few minutes for air to flow into bellows, then check clearance between axle bumpers and axle (fig. 4). If clearance is appreciably more or less than 3-3/8", adjust overtravel lever on each height control valve as necessary to obtain this dimension. Refer to "Ride Height Check and Adjustment" earlier in this section. Make sure lever adjusting screw is tight when adjustment is completed.

13. Check for air leakage at all bellows upper and lower mountings. Coat mountings with soap and water solution and watch for appearance of soap bubbles. No leakage is permissible. If leakage is evident, bellows must be disconnected and mating surfaces must be cleaned. Bellows must be replaced if bead is damaged.

RADIUS RODS

All radius rods, and lateral stay rod used at front axle, are hollow steel tubes with steel forgings welded to each end. Rear axle upper radius rods are interchangeable with each other, rear axle lower radius rods are interchangeable with each other, and the two front axle radius rods are interchangeable with each other; however, radius rods are not interchangeable between front and rear axles. The front upper radius rod is two-

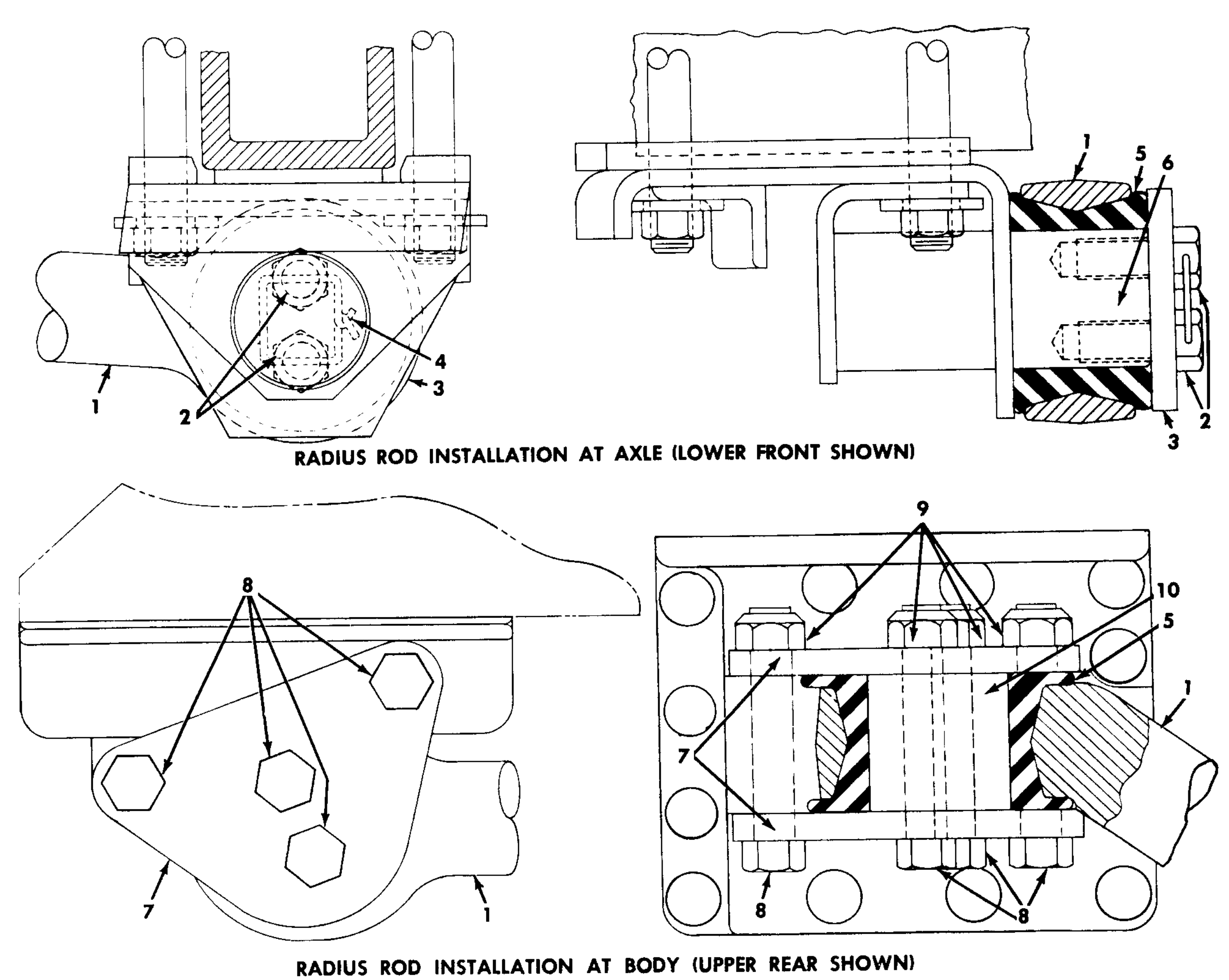
piece and threaded into a clamp and locked by two bolts, therefore an adjustment for front axle caster is provided. All front and rear radius rod bushings, anchor plates, and anchor plate spacers are interchangeable.

Radius rod connections at axle and at body are illustrated in figure 8 while anchor pin installations and body brackets at various points differ from the ones shown, attaching parts are identical at all points. Lateral stay rod at front end is connected at axle and at body bracket in same manner as shown in figure 8 for radius rod connection at axles.

RADIUS ROD REPLACEMENT (Fig. 8)

The following procedures include instructions for disconnecting and connecting radius rods at body and at axles. Radius rods must be disconnected at body before axle end can be removed from anchor pin. Instructions applying to radius rod connections at axle also apply to the front axle lateral stay rod. Raise body just enough to remove weight from air bellows and block in position before disconnecting radius rods or front axle lateral stay rod.

IMPORTANT: When any radius rod or the lateral stay rod has been disconnected, correct height



1 Radius Rod
2 Cap Screw
3 Anchor Pin Washer
4 Lock Wire
5 Radius Rod Bushing
6 Anchor Pin
7 Anchor Plate
8 Anchor Plate Bolt
9 Bolt Nut
10 Anchor Plate Spacer

TPM-5516

Figure 8—Radius Rod End Mountings

control clearance between axle bumpers and axles must be obtained before tightening anchor pin cap screws or anchor plate bolts. If connections are tightened without first obtaining this clearance, a torsional preload will be imposed on the rubber bushings when the body assumes its normal ride height relative to the axles. Instructions under "Tighten Cap Screws and Bolt Nuts" must be followed explicitly.

RADIUS ROD BUSHING REPLACEMENT

A special tool (fig. 10) which can be made locally, is effective when removing or installing one-piece rubber bushing in radius rod. Use of tool is illustrated in figure 9. Position tool over bushing as shown, then swing tool arms in direction of arrows to fold the bushing. With bushing folded on tool it can be easily removed or installed. Swing arms in opposite direction to unfold bushing and withdraw tool.

Remove Radius Rod at Body

Remove nuts from four anchor plate bolts, then remove bolts and anchor plates.

NOTE: Access to rear ends of rear axle upper radius rods is from under vehicle through opening between bulkhead at rear of wheelhousings and engine bulkhead.

Remove Radius Rod at Axle

Cut lock wire and remove wire from cap screws. Remove anchor pin washer. Pull radius rod and bushings off anchor pins.

Inspection

Inspect radius rods for bent condition and for

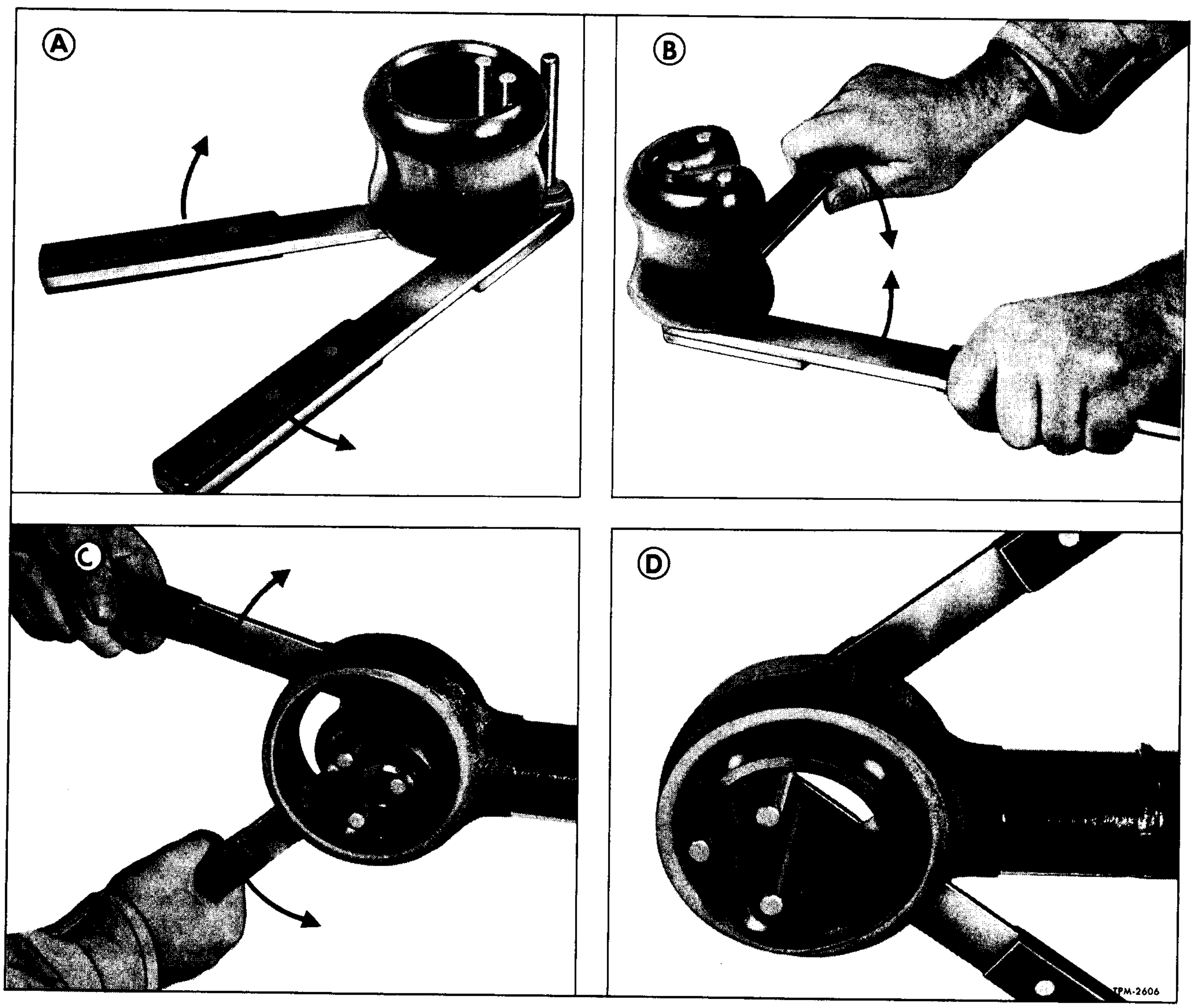


Figure 9—Use of Radius Rod Bushing Installer Tool

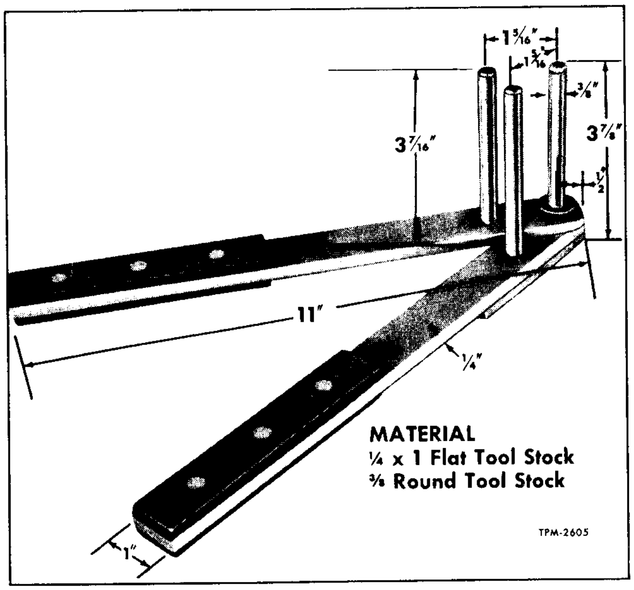


Figure 10—Radius Rod Bushing Installer Tool

cracks. Any damage necessitates replacing with new part. Always use new rubber bushings at assembly. Thoroughly clean rod ends, anchor plate spacers, anchor pins, and anchor plates; any surface contacting rubber bushings must be clean, smooth, and dry. USE NO LUBRICANT (NOT EVEN WATER) ON BUSHINGS.

Install Radius Rod at Axle

Install anchor pin washer. Install two cap screws but do not tighten.

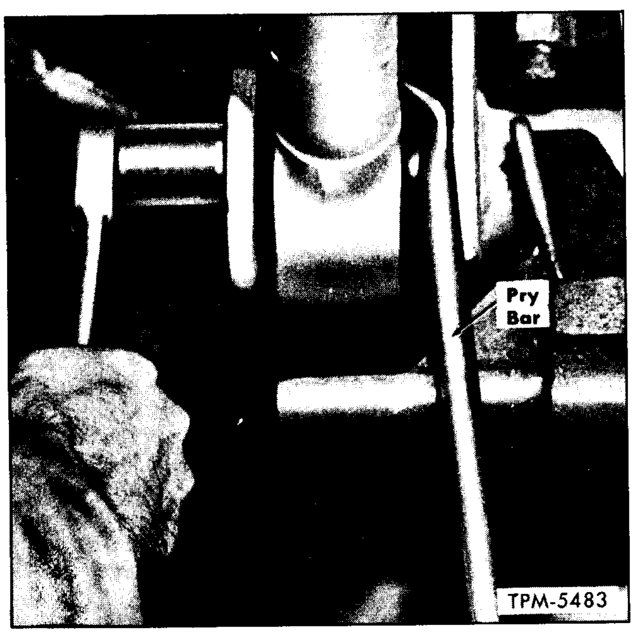


Figure 11—Tightening Radius Rod Cap Screws

Install Radius Rod at Body

1. Install anchor plate spacer in radius rod end.

2. Temporarily insert a 3/4 x 5-inch bolt through center hole in one anchor plate, insert bolt through upper hole in anchor plate spacer, then place other anchor plate over bolt. Install nut on bolt and tighten finger-tight.

3. Align other holes in anchor plates with holes in bracket and spacer and insert three permanent 3/4 x 4-1/4-inch bolts. Coat threads with No. 110 Lubriplate. Tighten nut on temporary bolt to draw anchor plates together, compressing rubber bushings, until nuts can be started on the other three bolts. Start nuts on bolts, remove temporary bolt, and install permanent bolt and nut.

Tighten Cap Screws and Bolt Nuts

1. Refer to "Installation Procedure" under "Front Axle and Air Suspension Installation" or "Rear Axle and Air Suspension Installation" for instructions on obtaining normal ride height clearance between axle bumpers and axles.

2. At body, alternately tighten each nut a little at a time to keep spacer centered in bushing. When tightened correctly space between radius rod and anchor plates will be equal on both sides.

3. At axle, use a pry bar to force radius rod end out toward anchor pin washer (fig. 11) while tightening anchor pin cap screws. Do not pinch edge of bushing with pry bar. Secure cap screw with lock wire threaded through head of cap screws.

4. Due to inaccessibility of rear axle upper radius rod rear nuts, torque wrench cannot be applied to nuts; tighten nuts until anchor plates are drawn up squarely and tightly against anchor plate bracket and spacer.

STABILIZER BAR

Stabilizer bar (fig. 12) is anchored to brackets on coach body bulkhead at rear axle. Bar helps to control vehicle stability. Rubber bushed clamps anchor bar firmly to brackets while links at each end of bar are attached to suspension supports. A retainer on bar is clamped flush against each inner rubber bushing.

REPLACEMENT

Removal

1. Remove cotter pins and nuts from link ball studs. Discard cotter pins. Remove both stabilizer bar links.

2. Support bar and remove bolts from bar clamps at each side. Remove clamps, stabilizer bar, and rubber bushings. Loosen clamp nut and move each bushing retainer aside, if necessary.

Installation

1. Space bushings properly and place stabilizer bar in position under coach. While supporting bar, loosely attach a bar clamp around each bushing with bracket bolt nuts.

2. Wipe all grease, oil, or foreign matter from link stud tapers and from tapered holes.

NOTE: To avoid a preload on link stud rubber mountings, install links when vehicle is at normal ride height. Refer to "Ride Height Check and Adjustment" earlier in this section.

3. Install links and secure with nuts. Tighten clamp bolt nuts and link stud nuts to torque listed in "Specifications" at end of this section. Advance each link stud nut to meet cotter pin slot and install new cotter pins.

4. If bushing retainers have been removed, place two halves around bar and against inside of rubber bushing. Slip retainer clamp over assembly and tighten nut to torque listed in "Specifications" at end of this section.

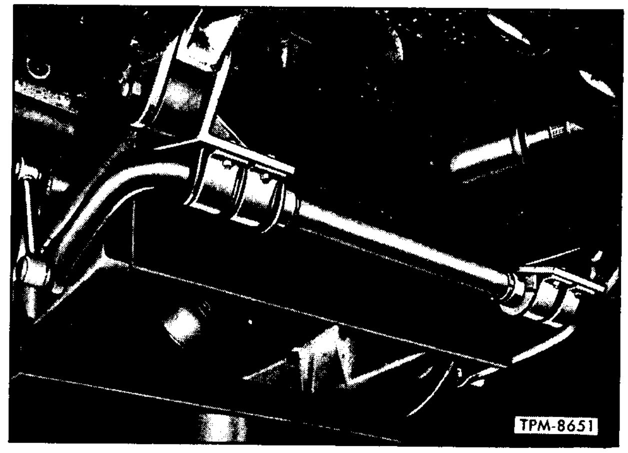


Figure 12—Stabilizer Bar Installed

AIR BELLOWS

Four "rolling lobe" type bellows made of rubberized nylon fabric are mounted at each axle (figs. 6 and 7). These "air cushions" provide the flexibility between axles and coach body. At the same time, the bellows retain the compressed air which supports the body. The outside diameter of the dismounted bellows for front axle is 6" and for rear axle is 8".

The square bead at each end of bellows is reinforced with wire. The opening at piston end (bottom) is smaller than opening at top. Bottom bead

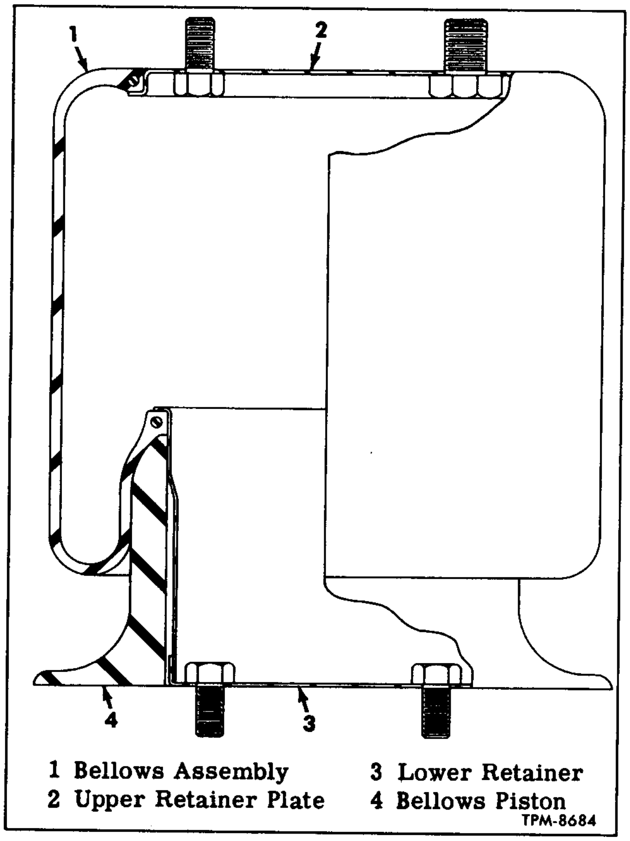


Figure 13—Sectional View of Air Bellows—Goodyear

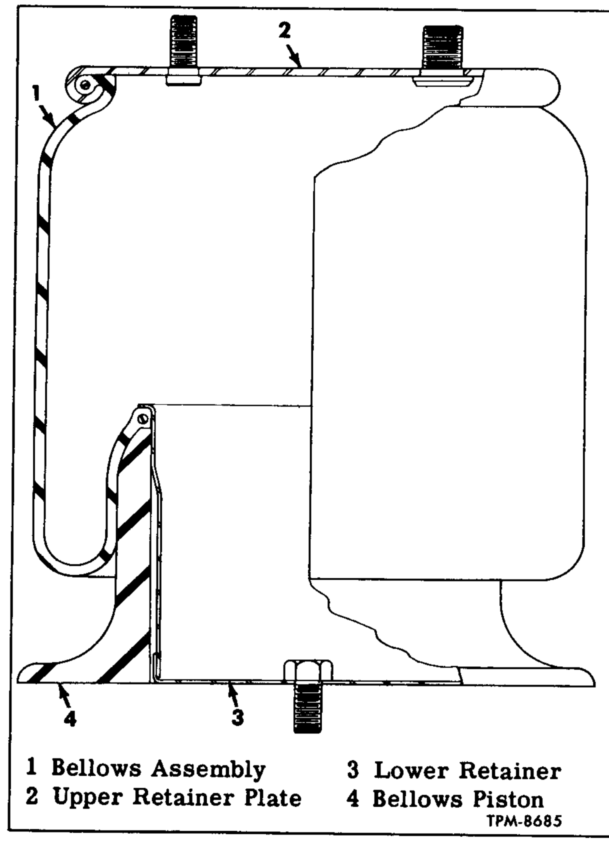


Figure 14—Sectional View of Air Bellows—Firestone

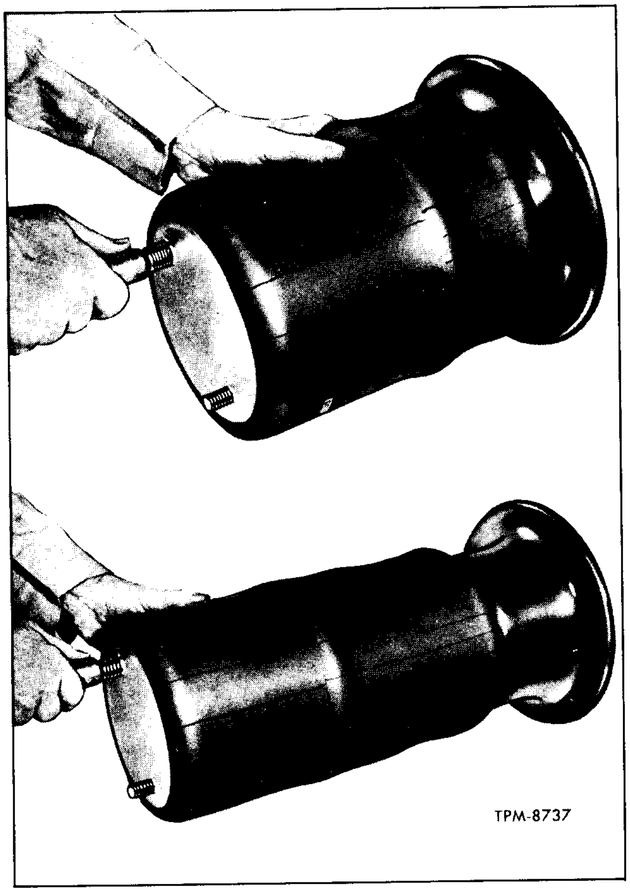


Figure 15—Removing Bellows Loop With Air Pressure

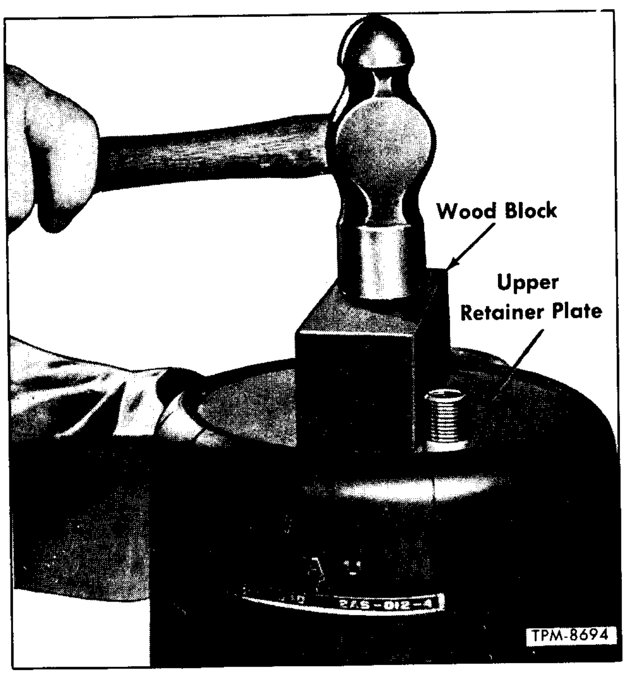


Figure 16—Loosening Retainer Plate From Bellows Bead

is clamped between lower retainer and upper edge of piston as shown in figures 13 and 14. When bellows is inflated, beads form air-tight seals. In operation, the bellows folds down over piston, taking a lobe-shaped contour. One of the studs in upper retainer is drilled and threaded for an air line connection.

REMOVAL

1. Securely support coach body by placing blocks under body at points indicated for respective axle and suspension removal procedure.

2. If system is pressurized, disconnect height control valve link (one at front and two at rear) then pull down height control valve overtravel lever to exhaust air from bellows. Do not change height control valve lever adjustment.

3. Remove four nuts and bolts attaching mounting plate to beam. Remove lock nut from stud at bottom of bellows assembly (one stud on each front bellows, two studs on each rear bellows). Collapse bellows to get clearance, then disconnect air line and remove bellows assembly.

4. Remove nut and lock washer from large stud and remove nut from small stud attaching mounting plate to upper retainer. Remove mounting plate.

DISASSEMBLY

NOTE: Bellows assembly shown in figure 14 can only be partially disassembled, therefore only

Figure 17—Removing or Installing Upper Retainer Plate

paragraphs 1 and 4 are applicable to Firestone bellows.

1. With bellows assembly on bench, apply air through hollow fitting in upper retainer (fig. 15) until loop or fold is removed and bellows is straight.
2. Place wood block across upper retainer, then drive with hammer (fig. 16) until retainer is loose from bellows bead.
3. Press bellows to elongate opening, in order that upper retainer can be removed (fig. 17).
4. In many instances it will be necessary to drive lower retainer out of piston. A locally made driving plate installed over end of retainer will prevent damage to retainer as it is driven from piston, as illustrated in figure 18.
5. Apply liquid soap or glycerine to lower retainer surface at point of bellows contact (fig. 19). Force screwdriver between retainer and bellows bead (fig. 19) to allow fluid to reach bellows bead.
6. When bead is loosened around entire surface of retainer, the retainer can be forced into bellows and removed through upper opening.

INSPECTION

Examine bellows inside and out for evidence of cracks, punctures, deterioration, or chafing. Replace with new bellows if any damage is evident. Any surface on upper and lower retainers or on piston that touches bellows should be smooth and free of cracks that might cause breaks or damage bellows. Check threads on studs. Replace any damaged parts.

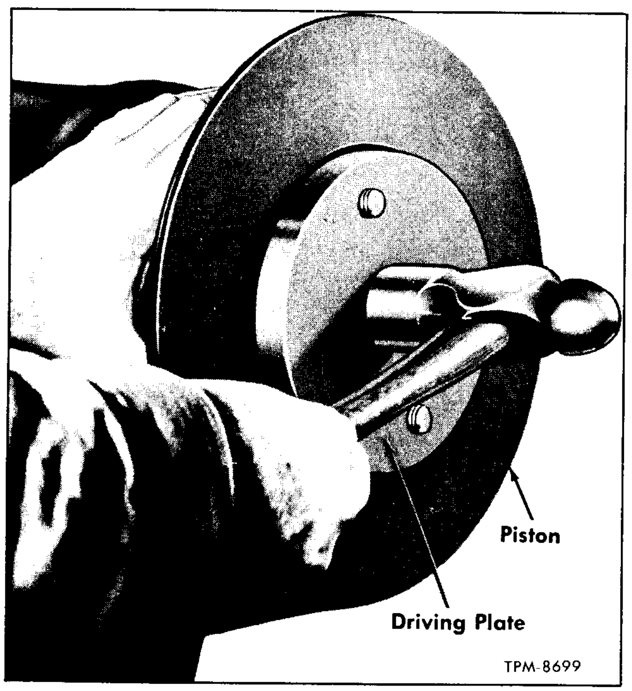


Figure 18—Removing Lower Retainer From Piston

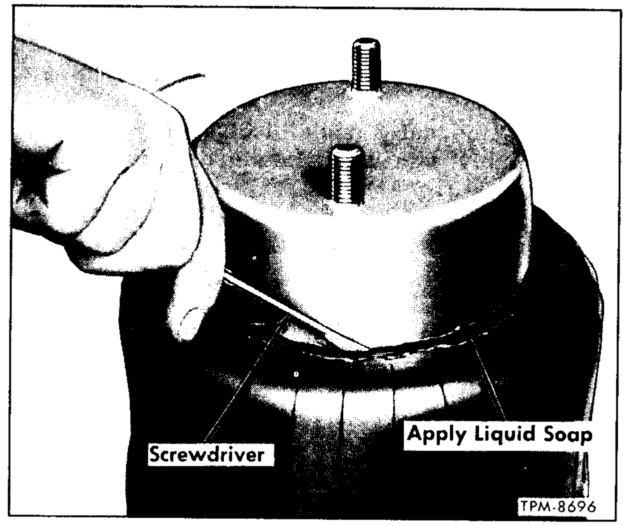


Figure 19—Loosening Bellows Bead From Lower Retainer

ASSEMBLY

NOTE: Bellows assembly shown in figure 14 can only be partially disassembled, therefore paragraphs 1 through 3 are not applicable to Firestone bellows.

1. Install lower retainer assembly through bellows upper opening and into lower opening.
2. Install upper retainer in place in bellows, being sure that studs in upper retainer are at right angle to studs in lower retainer.
3. Apply air in bellows through opening in upper retainer stud (fig. 20) to seat lower and upper retainers in bellows.
4. Install piston over lower retainer.
5. Install air supply valve in upper retainer stud, then inflate bellows to 5 pounds pressure.
6. Using block of hard wood (1" x 10"), drill two 1" holes so that block will fit over two studs in upper retainer.

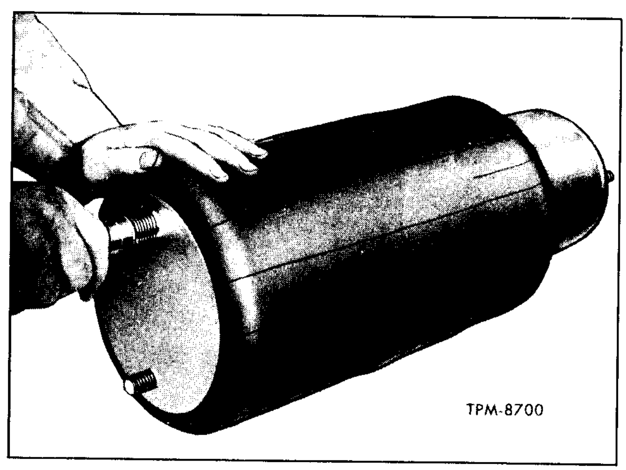


Figure 20—Seating Retainers in Bellows With Air Pressure

AIR SUSPENSION

7. Install bellows assembly in arbor press (fig. 21) with two studs in lower retainer astride a block so that assembly will rest against retainer and piston.

8. Install locally made block over top of bellows assembly with upper retainer studs through holes in block (fig. 21).

9. Operate arbor press so to compress air and cause lower end of bellows to fold over piston. Continue to press until a dimension of approximately 12" overall height is obtained (fig. 22).

WARNING: Before releasing arbor press be sure that air is released from bellows by opening air valve.

10. Remove assembly from arbor press, then remove wood block and air supply valve.

INSTALLATION

1. Place bellows assembly in position between suspension support and beam.

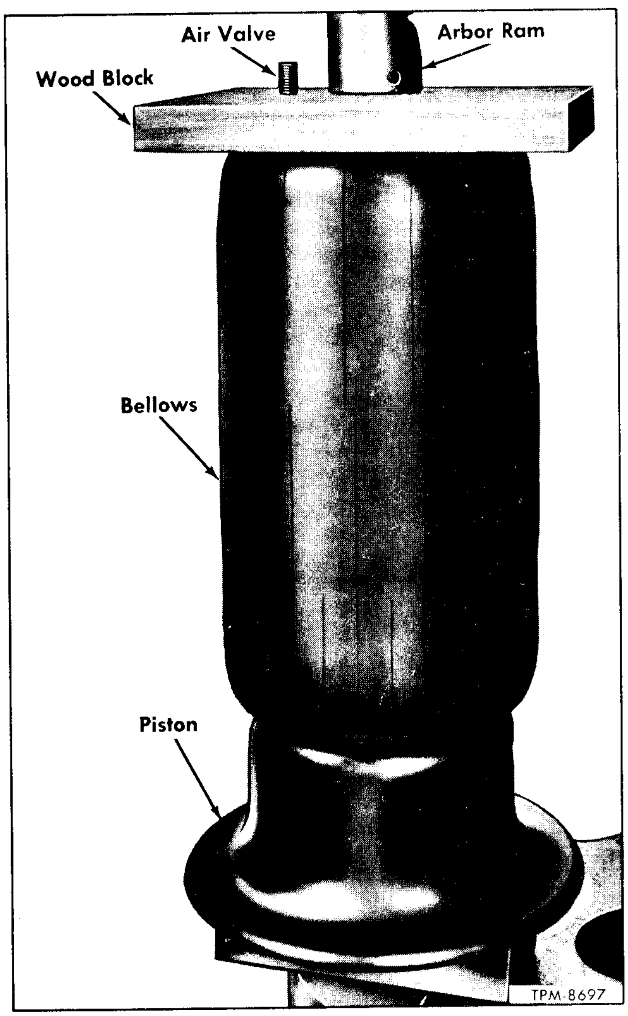


Figure 21—Forming Bellows Loop Over Piston Using Arbor Press

2. Place mounting plate over studs in upper retainer. Edges of plate of front axle should extend downward. Install large nut and lock washer on large stud, and small nut on small stud. Tighten nuts to torque listed in "Specifications."

Front Bellows. The larger of two studs at top of each bellows assembly should be away from front axle. Seat mounting plate solidly against beam and attach with four bolts and lock nuts. Insert bolts from bellows side of plate. Install nut on stud at bottom of bellows. Tighten all nuts to torque listed in "Specifications."

Rear Bellows. The larger of two studs at top of each bellows assembly should be toward rear axle. Attach mounting plate with four bolts and four lock nuts. Install two lock nuts on studs at bottom of bellows. Tighten all nuts to torque listed in "Specifications" at end of this section.

4. Connect height control valve links, if disconnected. Make sure lever adjustment has not been changed.

5. Build up air pressure in system to normal operating pressure. Remove blocks from under coach.

6. Check for air leaks at upper and lower mountings of bellows by coating with solution of soap and water. Any leaks showing up as bubbles must be stopped.

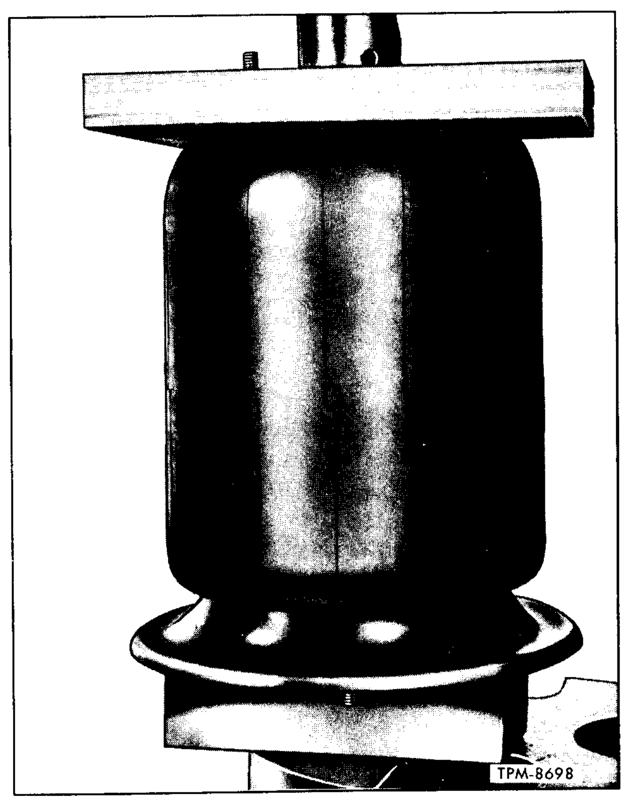


Figure 22—Bellows Loop Rolled Over Piston

CHECK VALVE

Check valve (fig. 23) is spring-loaded ball type, permitting compressed air to flow in one direction only. Valve is located in air line between pressure regulating valve and suspension air tank. Check valves should be removed, disassembled, and cleaned at regular intervals. Check valve ball should be replaced if any wear or roughness is evident. Use a new gasket between valve cap and body when assembling valve. When installing valve, make sure that arrow stamped on valve cap points toward tank.

PRESSURE REGULATING VALVE

Pressure regulating valve (fig. 24) is mounted on coach body near suspension air tank. This valve serves two purposes. One purpose is to prevent entry of compressed air into air suspension system until pressure in air brake system reaches 65 psi. This makes possible a rapid build-up of air pressure for operation of air brakes. When brake system air pressure exceeds 65 psi, the pressure regulating valve opens and allows pressure to build up in suspension system. The second purpose of the valve is to prevent loss of brake system air pressure below 65 psi due to leakage in suspension system.

SERVICEABILITY TESTS

1. Operating Test

a. Exhaust compressed air from air system by opening drain cock at air tank. Close drain cock when tank is empty.

b. Connect a test air pressure gauge in brake system, preferably in line leading from air tank to pressure regulating valve.

c. Disconnect air line at bottom of pressure regulating valve.

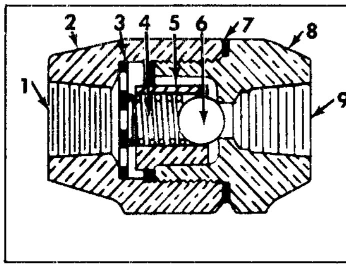
d. Build up air pressure in system and note pressure on test gauge at instant valve opens and discharge air through open line.

e. Adjust valve if pressure varies 5 psi from the original setting (65 psi).

2. Leakage Test

With air line still disconnected at bottom of valve, build up air pressure to a point just below valve setting (65 psi). Coat opening with soap suds to check for leakage. Also apply soap suds to vent opening in valve cover.

No leakage is permissible at vent opening in valve cover. Leakage at this point indicates a ruptured diaphragm. Replace ruptured diaphragm with new part.



1 Air Outlet
2 Body
3 Spring Seat
4 Spring
5 Ball Guide
6 Ball
7 Gasket
8 Cap Nut
9 Air Inlet TP-9369

Figure 23—Air Tank Check Valve

Leakage amounting to a 3-inch bubble in 3 seconds at outlet port is permissible. Excessive leakage is an indication of a dirty or worn valve or valve seat.

ADJUSTING PRESSURE SETTING (Fig. 24)

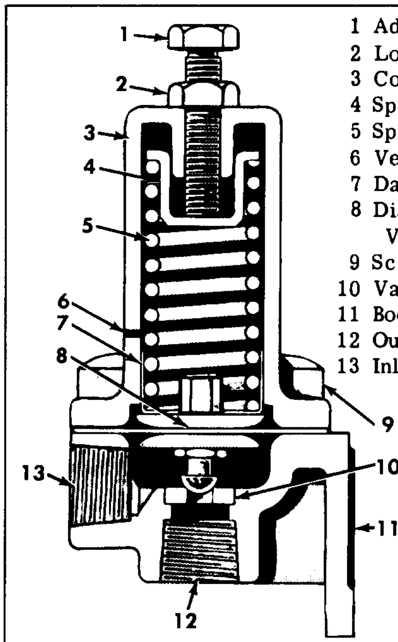
The adjusting screw (1) controls the pressure at which the valve is unseated. Setting may be increased or decreased by turning screw.

1. Back off lock nut (2). Turn screw clockwise to increase pressure, or counterclockwise to decrease pressure.

2. Tighten lock nut (2) when correct adjustment is obtained.

DISASSEMBLY

Remove four screws (9) attaching cover (3) to body (11) and remove cover. Remove spring seat (4) and damper (7) from cover. Lift diaphragm and valve assembly (8) off body.



1 Adjusting Screw
2 Lock Nut
3 Cover
4 Spring Seat
5 Spring
6 Vent
7 Dampener
8 Diaphragm and Valve Assembly
9 Screw
10 Valve Seat
11 Body
12 Outlet Port
13 Inlet Port

TPM-2223-1

Figure 24—Pressure Regulating Valve

INSPECTION

Clean all parts thoroughly, using a suitable cleaning solvent. Examine diaphragm for cracks or wear. If either the valve or the diaphragm are worn or damaged, a new valve and diaphragm assembly (8) must be installed. Inspect valve seat (10) in body. If seat is pitted, scratched, or chipped, it should be replaced.

ASSEMBLY (Fig. 24)

Place diaphragm and valve assembly (8) on body, with valve seated in valve seat in body. Install spring seat (4), spring (5) and damper (7) in cover (3) and position cover on body. Install four screws (9) through cover and diaphragm into body, and tighten firmly. Connect air pressure source to valve inlet and adjust set pressure as previously directed.

HEIGHT CONTROL VALVE

DESCRIPTION

Height control valves operate automatically. Valves control the flow of compressed air into or out of bellows. Body of each height control valve contains intake valve, exhaust valve, and delay piston. Overtravel control body contains a spring-loaded nylon piston. Piston protects valve parts when overtravel lever is moved beyond normal operating range, and also provides a delay in the action of the valve so air is not used during momentary bumps, but only on load changes.

Three height control valves are used in coach air suspension system; one at front axle (fig. 25) and two at rear axle (fig. 26). The valve at center of front axle has two air supply outlets, one for left-hand set and one for right-hand set of bellows. Each rear valve has a single outlet to supply air to bellows on that side.

Except for valve body and overtravel shaft, parts in all three valves are similar. Front valve also contains a ball check valve in each inlet port and in each outlet port to prevent passage of air pressure from one side of the vehicle to the other. Each check valve consists of a small nylon ball.

HEIGHT CONTROL VALVE OPERATION

Figure 27 shows cross-section of valve assembly in the three phases of operation. Valve

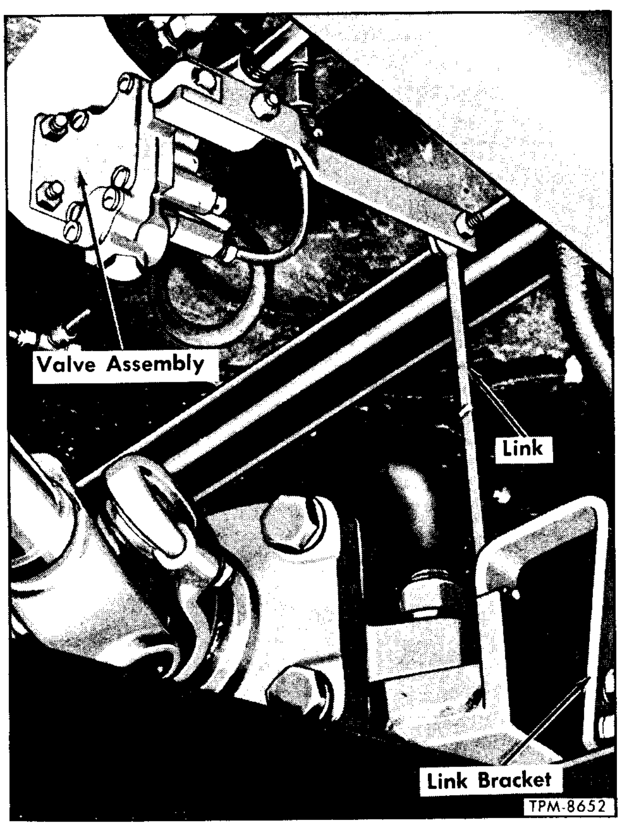


Figure 25—Front Height Control Valve Installed

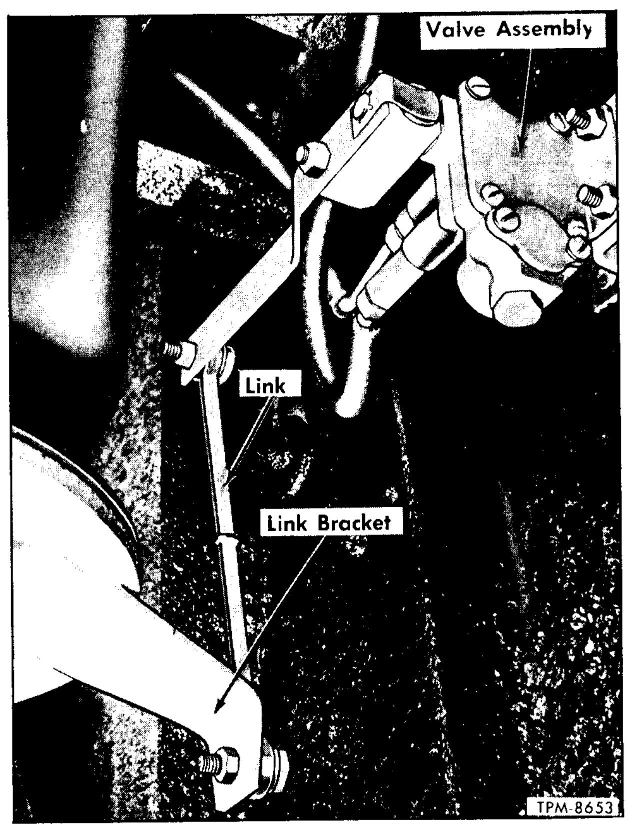


Figure 26—Rear Height Control Valve Installed

operation is illustrated as coach is unloaded, at normal ride height, and as coach is loaded. Each valve independently adjusts for the following conditions:

LOADING (Fig. 27)

When coach is loaded, coach body settles. Since valve is linked to suspension, and valve is bolted to body, valve moves downward with body as body is loaded. As overtravel lever and control shaft turns, inlet valve lever moves over against pin of valve core. As pin is pushed in, air pressure flows through height control valve into bellows. Increased air pressure expands bellows and raises body.

Inlet valve is "protected" by check valve (23, fig. 35) in inlet adapter. Light spring in core freely admits tank air, but return flow of air is blocked.

NEUTRAL POSITION (Fig. 27)

As increased air pressure expands bellows and lifts body, the height control valve moves upward with body. As body is returning to normal ride height, overtravel arm and shaft return to a neutral position. Inlet valve lever also moves away from inlet valve core and inlet valve closes. This stops the flow of air into the bellows. The exhaust valve remains closed. Since the exhaust valve is closed, and the check valve in the inlet adapter prevents compressed air from returning to tank, air is trapped in bellows and in valve. No further valve action or air pressure change takes place until load is increased or decreased, moving overtravel lever out of neutral position for one second or more to actuate intake valve or exhaust valve.

UNLOADING (Fig. 27)

When part of load is removed, air pressure in bellows lifts body. Overtravel lever, linked to suspension, is pulled downward from neutral position. This applies a force on the delay piston which moves it slowly. The exhaust valve lever moves with the delay piston. The outer end of exhaust valve lever fits around stem of exhaust valve core. As soon as lever moves beyond free-travel range, lever pulls on stem and opens exhaust valve. Inlet valve remains closed. Compressed air from bellows then flows through the open exhaust valve and out exhaust fitting to atmosphere. As the compressed air is exhausted from bellows, the body lowers until overtravel lever and shaft are again in normal (neutral) position.

OVERTRAVEL LEVER FREE TRAVEL

With vehicle in motion and body at normal ride height, control valve overtravel lever and shaft are in neutral position as shown in figure 27. Small irregularities in road cause up and down movement of overtravel lever. Clearances are provided between operating levers and cores of inlet and exhaust valves to permit 3/16" up or down movement of overtravel lever from neutral position without causing valve action.

HYDRAULIC DELAYING ACTION

Operation of a delay piston (5, fig. 35) in height control valve prevents change of bellows air pressure as result of momentary road shocks, conserves air pressure, and adds life to valve. The nylon piston moves inside cylinder containing a silicone type fluid. A flapper valve on either end of

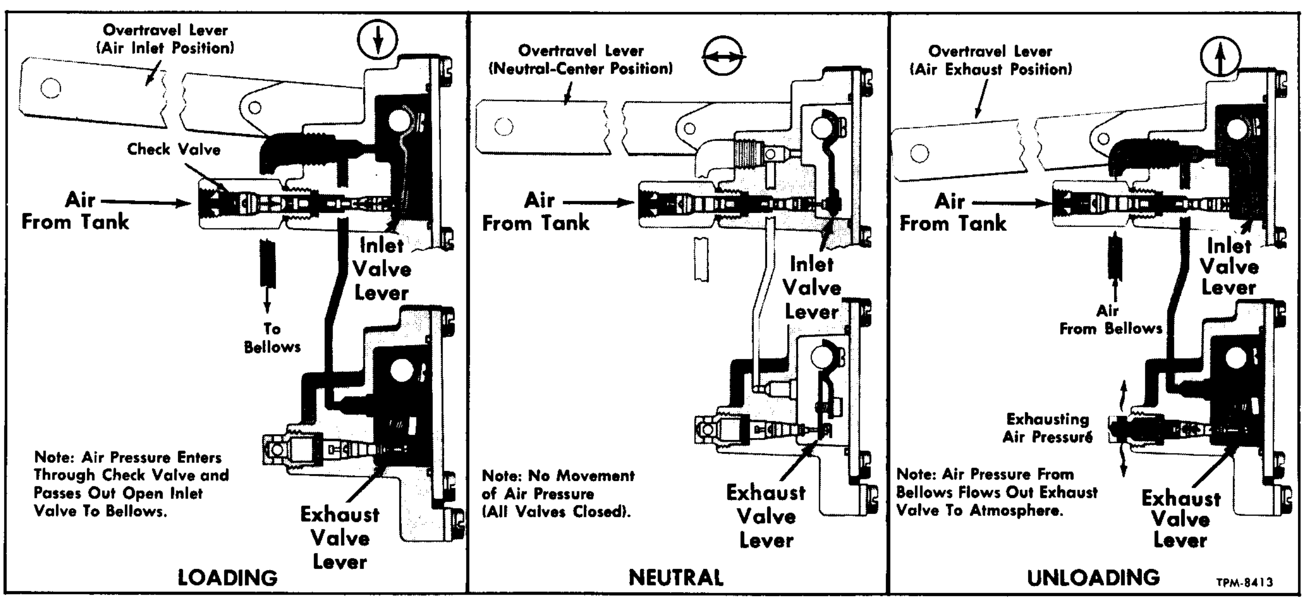


Figure 27—Operation of Height Control Valve

piston allows displacement of fluid or acts as a check valve, depending on direction piston moves. Delay piston is moved by piston pin (16, fig. 35) that is threaded into overtravel shaft. A one to six second delay results from the closing of one valve to the cracking of other valve. Intake and exhaust valves close from full open position within 1 second.

Overtravel piston (31, fig. 35) is held against flat side of overtravel shaft by two springs inside piston. Piston keeps overtravel shaft in proper position relative to overtravel lever. Piston also allows overtravel lever to rotate through a complete circle, without damaging parts inside valve.

HEIGHT CONTROL VALVE REMOVAL

Before disconnecting any height control valve air lines, securely support body by placing blocks under coach at jack pads. Exhaust air from air supply system by opening drain cock in suspension air tank. After the above precautions have been taken, remove height control valve as follows:

1. Disconnect height control valve overtravel lever from valve link. Pull lever downward to release compressed air from bellows.
2. Disconnect air supply line and bellows air line from height control valve. Tape ends of all lines closed.
3. Remove two bolts, lock washers, and nuts attaching height control valve to mounting bracket and remove valve assembly.

HEIGHT CONTROL VALVE INSTALLATION

Before installing height control valve assembly, see that air line fittings are clean and undamaged. Replace line connector rubber gaskets (40, fig. 35) if deteriorated or damaged.

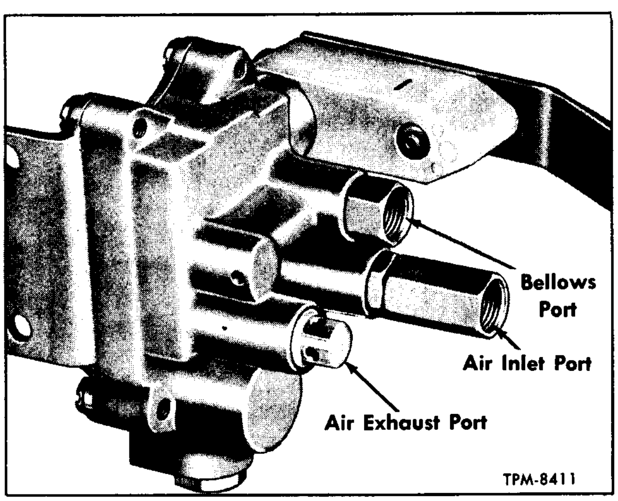


Figure 28—Identification of Valve Air Ports

IMPORTANT: Absolute cleanliness is essential when installing height control valves. Dirt and sealing compound must be kept out of valves. Even minute particles of foreign matter may become lodged in valve cores or flapper valves and may seriously affect operation of suspension system.

Install valves as follows:

1. Position height control valve at mounting bracket and attach with two bolts, nuts, and lock washers. Tighten firmly.
2. Connect air supply line to inlet check valve adapter. Connect bellows air line to bellows port (two at front valve). Tighten air line connector nuts firmly.
3. Connect height control valve overtravel lever to valve link. Build up air pressure in system and test for leaks. Check ride height dimensions. Make adjustments as directed following:

HEIGHT CONTROL VALVE AIR LEAKAGE CHECK

NOTE: Air leakage check can be made when valve is installed on vehicle only for bellows mountings and air line connection leaks. The following instructions explain procedure for making air leakage check when valve assembly is removed from the vehicle.

1. Clean exterior of valve assembly.
2. Connect air pressure line to air inlet port (fig. 28), then open the air pressure (80-110 psi).
3. Submerge valve assembly in a container of water, then watch for air bubbles when the overtravel lever is in the center position. No air should escape from any point of valve assembly.
4. If bubbles appear from the bellows port, this is an indication that the air inlet valve assembly is defective and must be replaced.
5. Remove air pressure line from air inlet fitting and connect it to the bellows port (fig. 28). If bubbles appear at the air inlet check valve port, this is an indication that check valve unit is defective and must be replaced.
6. If bubbles appear at the exhaust port (fig. 28), it is an indication that the exhaust valve assembly is defective and must be replaced.
7. If bubbles appear around edge of valve cover plate, the cover plate rubber O-rings must be replaced.
8. If no leaks are detected, remove valve assembly from the water, then with air pressure still connected to the bellows port, actuate overtravel lever to expel any excessive amount of water which may have entered exhaust valve chamber. Remove air line and connect it to the air inlet port and repeat operation here to remove water from air inlet valve chamber.

TROUBLESHOOTING HEIGHT CONTROL VALVE

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE MEASURE
1. Bellows deflate overnight.	a. Defective check valve assembly.	a. Replace check valve assembly.
	b. Defective exhaust valve assembly.	b. Replace exhaust valve assembly.
	c. Leak in air line and/or bellows.	c. Replace air line or bellows.
	d. Defective valve cover rubber O-rings.	d. Replace valve cover O-rings.
2. Bellows raise to full height and fail to exhaust air pressure.	a. A clogged exhaust screen (20, fig. 35) in height control valve assembly.	a. Remove, then clean screen.
	b. A combination clogged exhaust screen and a defective air inlet valve assembly.	b. Clean exhaust screen and replace air inlet valve assembly.
3. Intermitten hissing noise at height control valve during operation.	a. Loss of time delay action fluid in height control valve assembly.	a. Add fluid, then install new cover and delay piston plug gasket O-rings.
4. Erratic valve action.	a. Dirt or foreign matter in the air valve lever chamber.	a. Remove valve cover and blow out dirt. Install cover using new rubber O-rings.
	b. Defective valves.	b. Overhaul height control valve assembly.
5. Vehicle body fails to level out.	a. Improper height control valve overtravel lever adjustment.	a. Make proper adjustments as directed previously under "Ride Height Check and Adjustment."

HEIGHT CONTROL VALVE ADJUSTMENTS

To properly adjust the height control valve, it is ESSENTIAL that the following procedures be followed and in the sequence mentioned.

Three main adjustments are required:

1. Overtravel lever center position adjustment.

2. Air intake and exhaust valve lever gap adjustments.

3. Time delay check.

NOTE: The height control valve assembly must be removed from vehicle to make the above adjustments.

Instructions for checking the ride height dimension are explained previously under "Ride Height Check and Adjustment."

IMPORTANT: The Silicone fluid should be drained from valve assembly before making the first two adjustments mentioned above.

NOTE: The following tools should be used when making valve adjustments.

REQUIRED TOOLS

Tool	Tool Number
Valve Core Replacer	J-6888
Overtravel Lever Piston Compressor	J-8424
Allen Wrenches (Sizes 3/32-inch and 1/8-inch)	Procure locally
Stop Watch	Procure locally

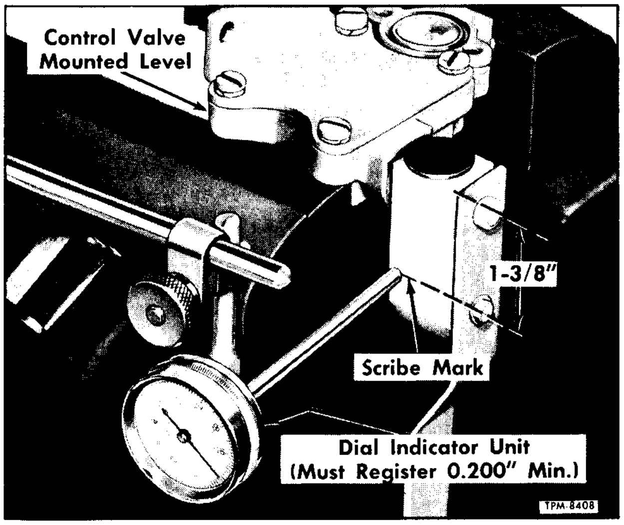


Figure 29—Dial Indicator Properly Installed

Tool	Tool Number
Dial Indicator Set (Having minimum range of 0.200 inch)	Procure locally
Air Line Fitting Assembly Consists of:	
(1) 2-Inch length of 1/4 H-9 hose	Procure locally
(1) Weatherhead pipe fitting	00904-104
(1) Weatherhead inverted fitting	00904-B04
Vacuum Line Fitting	Sun Tester #115-3
Depth Gauge and Straightedge	Procure locally
Conventional Type Eye Dropper	Procure locally

OVERTRAVEL LEVER CENTER POSITION ADJUSTMENT

1. Clean exterior of valve assembly.
2. Remove covers and rubber O-rings from valve assembly, then drain off the Silicone fluid.
3. Remove exhaust plug (21, fig. 35) and exhaust screen (20, fig. 35) from valve.
4. Referring to figure 29, scribe a line 1-3/8 inch from plug end of overtravel control body.

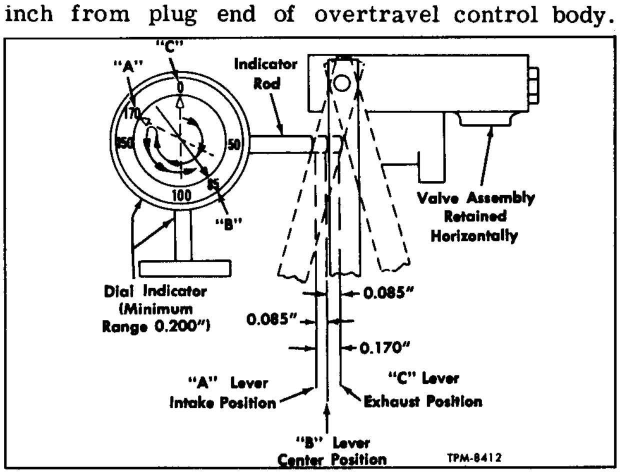


Figure 30—Locating Valve Overtravel Lever Center Positions

5. Place valve assembly in vise as shown in figure 29.
6. If a vacuum source is available, attach supply hose to valve exhaust port (fig. 28) using Sun Tester fitting #115-3 or equivalent. Do not apply vacuum at this time.
7. Attach air pressure supply hose to air inlet port (fig. 28). Do not apply pressure at this time.
8. Locate dial indicator in position as shown in figure 29. Place overtravel lever forward to air exhaust position (delay piston flush with top of bore) without overtraveling (position "C," fig. 30). Relocate indicator push rod to just contact 1-3/8 inch mark on control body and reset indicator dial to zero (0) at this point (position "C," fig. 30).
9. Move overtravel lever rearward to air intake position without overtraveling (position "A," fig. 30) (delay piston at bottom of bore). Take indicator reading which may vary from 0.160" to 0.190".
10. Repeat Steps 7 and 8 above to recheck this reading.
11. Divide the total travel dimension by two (example: 0.170" ÷ 2 = 0.085"), then move overtravel lever back this amount (0.085") to the center (position "B," fig. 30).

IMPORTANT: Without disturbing lever center position, reset indicator dial to zero (0), which actually is 0.100" on indicator of type registering 0.100" for each revolution of indicator needle, then proceed with valve lever gap adjustments following:

AIR INTAKE AND EXHAUST VALVE LEVER ADJUSTMENTS

IMPORTANT: Before making these adjustments, the overtravel lever must be centered as explained previously.

Two methods of adjustment are available:

1. Using Both Air Pressure and Vacuum.

NOTE: If vacuum source is available, this method will take less time to perform adjustment. Vacuum source is used to make the exhaust valve lever gap check only.

2. Using Air Pressure Only.

NOTE: When this method is used, it will take longer to perform adjustments as the valve cover must be in place each time air pressure is applied and then removed to permit turning of exhaust valve lever adjustment screw.

Both methods are explained as follows:

METHOD USING AIR PRESSURE AND VACUUM

1. If air supply and vacuum lines were not connected to valve assembly as directed previously when centering valve overtravel lever, connect lines.
2. Apply air pressure and regulate it to 80 to 110 psi. Apply vacuum and regulate it at approximately 15 inches.

3. Move overtravel lever fore and aft several times and then back to true center position.

4. Starting at true center position, slowly move lever rearward to where air intake valve just begins to open. Listen for escaping air. Note reading on dial at this point. Reading should be 0.025" to 0.027" from lever center position. Using a 3/32-inch hex wrench, adjust screw on intake valve lever (left view, fig. 31) until correct setting is obtained.

5. Return overtravel lever to center position. Slowly move lever forward to exhaust side and at same time note the vacuum gauge reading. When vacuum just begins to fall off, the exhaust valve has opened. Valve should open when overtravel lever is moved 0.035" to 0.037" from center position. Using a 1/8-inch hex wrench, adjust exhaust valve lever adjustment screw as shown in right view, figure 31 as required.

NOTE: If the adjustment screw is turned in too tight it must be backed off, and the two arms of exhaust lever spread apart as lever arms are not of the spring-back type. If this action was performed, repeat adjustment procedure above.

6. Recheck intake and exhaust valve lever gaps, then proceed with "Time Delay Check" explained later.

METHOD USING AIR PRESSURE ONLY

NOTE: This method may be performed when a vacuum source is not available.

1. Connect air supply hose (80 to 110 psi) to air inlet port (fig. 28).

2. To adjust air intake valve lever gap:

a. Move the overtravel lever rearward slowly from true center position to point where intake valve just begins to open. Listen for escaping air. Note reading on dial at this point which should register 0.025" to 0.027".

b. Using a 3/32-inch hex wrench adjust screw on intake valve lever (left view, fig. 31) until specified adjustment is obtained.

3. To adjust air exhaust valve lever gap:

a. Install valve cover on the valve using the two rubber O-rings and four attaching screws.

b. Being careful not to disturb indicator setting, disconnect air supply from the air inlet port and connect it to the bellows port (fig. 28).

c. Move overtravel lever slowly forward to open exhaust port while observing the indicator dial. Air should start to escape from exhaust port when indicator registers 0.035" to 0.037". If adjustment is necessary, shut off air pressure supply and remove valve cover. Adjust screw setting, then install cover and recheck valve opening dimension.

NOTE: Turning adjustment screw clockwise reduces gap dimension and overtravel lever movement dimension. If the adjustment screw is turned in too tight, it must be backed off, and the two arms of exhaust lever spread apart. If this action was necessary repeat adjustment procedure above.

d. Recheck valve lever gaps, then proceed with "Time Delay Check" following:

TIME DELAY CHECK

PRELIMINARY PROCEDURES

After the valve lever gaps have been properly adjusted, the time delay check must be performed.

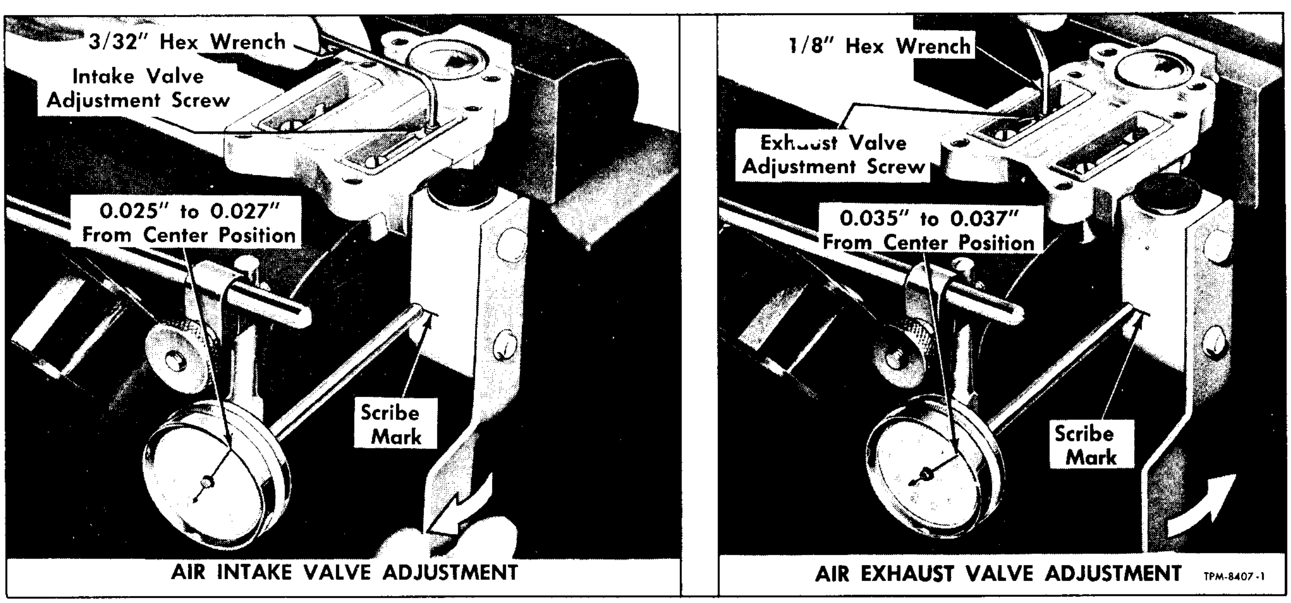


Figure 31—Method of Adjusting Air Valve Lever Gaps

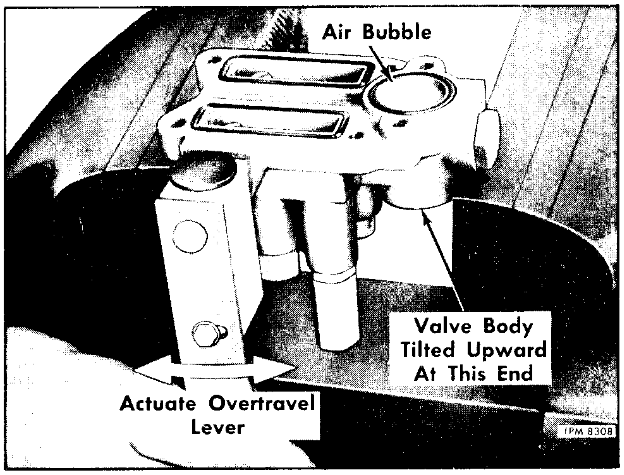


Figure 32—Venting Air From Silicone Fluid

A one to six seconds delay from the closing of one valve to the opening of the other is recommended. Also, valves should close from full-open position within one second.

1. Place new O-ring (17, fig. 35) over delay plug (18, fig. 35), then install plug into valve body. Tighten plug to 20-30 inch-pounds torque.

2. Pour 5.5 cc $\pm$ 0.25 cc of Silicone fluid (750 Centistokes viscosity at 25^{o}C) into delay piston bore. With valve body tilted slightly as shown in figure 32 carefully operate overtravel lever fore and aft to vent air from fluid. When all air has been expelled from piston pin cavity, check fluid level using depth gauge as shown in figure 33.

IMPORTANT: With valve assembly level, take measurement from center of bore only. Add or remove fluid to bring fluid 1/8-inch from top of valve body. An eyedropper will serve for this purpose.

3. Place new delay piston cover O-ring in groove of valve body. Install cover with two attaching screws and tighten to 20-25 inch-pounds torque.

4. Place valve assembly vertically in holding vise (fig. 34).

5. Cycle arm up and down for approximately one minute.

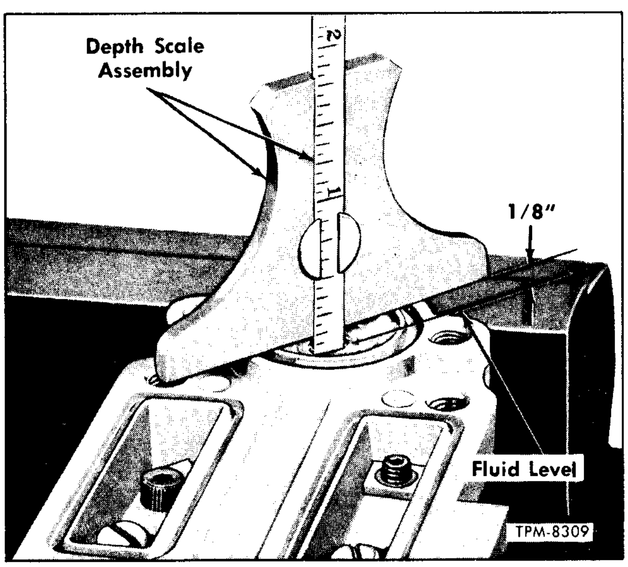


Figure 33—Measuring Fluid Level

AIR INLET TIME DELAY CHECK

1. Connect air pressure supply hose to valve air inlet port (fig. 28).

2. Move the overtravel lever upward (quickly) approximately two inches and simultaneously start counting the number of seconds before air starts to escape from bellows port. A delay of one to six seconds should exist. Repeat this check.

AIR EXHAUST TIME DELAY CHECK

To time the delay for exhaust, two methods can be used; one using vacuum source and one using air pressure.

1. Method Using Vacuum

a. Connect vacuum hose to air exhaust port (fig. 28). Adjust vacuum to 15 inches.

b. Move the overtravel lever downward (quickly) approximately two inches and simultaneously start counting the number of seconds before the vacuum gauge starts to drop off. A delay of one to six seconds should exist. Repeat this check.

2. Method Using Air Pressure

a. Install valve cover with rubber O-rings on valve assembly.

b. Connect air pressure supply hose to bellows port (fig. 28).

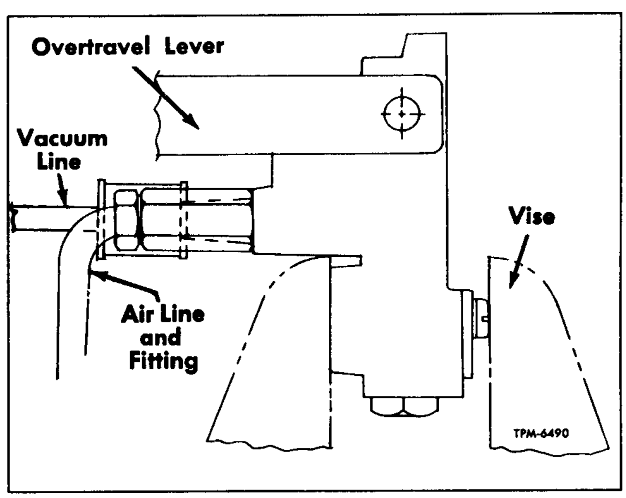
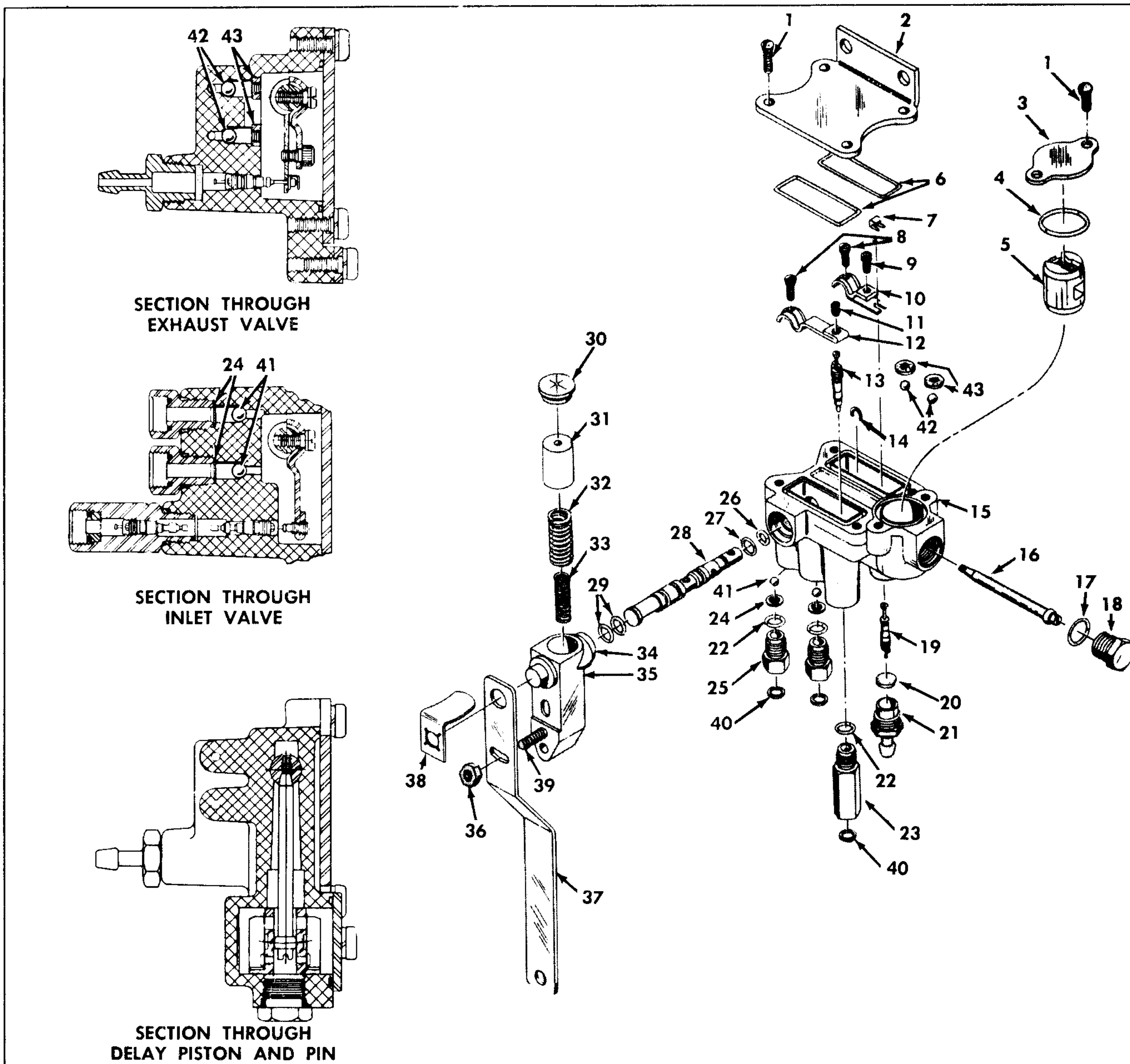


Figure 34—Valve Positioned For Time Delay Check



1 Cover Screw and Lock Washer	16 Piston Pin	30 Overtravel Body Plug
2 Cover and Bracket	*17 Plug O-ring	31 Overtravel Piston
3 Cover	18 Delay Plug	32 Overtravel Spring (Large)
* 4 Cover O-ring	*19 Exhaust Valve Core	33 Overtravel Spring (Small)
5 Delay Piston	*20 Exhaust Screen	*34 Overtravel Control Body Seal
* 6 Cover and Bracket O-ring	21 Exhaust Fitting	35 Overtravel Control Body
* 7 Valve Stem Lock Clip	*22 Adapter O-ring	36 Lever Stud Nut
8 Valve Lever Screw	23 Inlet Adapter and Check Valve Assembly	37 Overtravel Lever
9 Exhaust Adjusting Screw	*24 Outlet Adapter Screen	*38 Plug Retainer
10 Exhaust Valve Lever	25 Outlet Adapter	39 Overtravel Lever Stud
11 Intake Adjusting Screw	*26 Shaft O-ring (Small)	*40 Air Line Fitting Gasket
12 Intake Valve Lever	*27 Shaft O-ring (Medium)	41 Nylon Balls
*13 Intake Valve Core	28 Overtravel Control Shaft	42 Nylon Balls
*14 Retaining Ring	*29 Shaft O-ring (Large)	43 Ball Retainers
15 Valve Body		

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Figure 35—Height Control Valve Components—Front Shown

c. Move overtravel lever downward (quickly) approximately two inches and simultaneously start counting the seconds before air starts to escape from the exhaust port. A delay of one to six seconds should exist.

IMPORTANT: A time delay over six seconds could mean too large a valve lever gap adjustment and a time delay under one second would mean too small a valve lever gap adjustment. If the time delay is not within one to six seconds, first recheck the fluid level. If fluid level is satisfactory, the valve lever gap adjustment must be repeated, step by step.

NOTE: After obtaining proper valve adjustments, install valve cover using new rubber O-rings. Install new screen (24, fig. 35) in bellows port, then using new O-ring (22, fig. 35), install outlet adapter (25, fig. 35) into bellows port. (NOTE: On front valves, two outlet adapters (25), screens (24), and nylon balls (41) are used.) If screen (20, fig. 35) was removed from exhaust port, install new filter and exhaust fitting (21, fig. 35).

NOTE: Place tape over ends of air line ports until such time valve assembly is installed on vehicle.

HEIGHT CONTROL VALVE OVERHAUL

Height control valves meter air into and out of the air suspension system. These valves are precision built and accurately adjusted. Parts must be carefully handled and assembled. Valves must also be accurately adjusted to insure proper operation after rebuild. Special tools mentioned previously should be used. Makeshift tools may break off chips that could lodge between valve and seats. Chips, dirt, and other foreign material could cause faulty valve operation.

NOTE: Repair parts kit is available which contains all parts usually requiring replacement in average overhaul. Parts in repair kit are indicated by asterisk (*) in figure 35.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 35.

1. Remove inlet adapter and check valve assembly (23) from valve body (15). Remove outlet adapters (25), outlet adapter screens (24), and nylon balls (41, front valve only). (Rear valves have only one outlet adapter (25) and no nylon balls are used.) Remove adapter O-rings (22). Remove air line fitting gasket (40) from adapters.

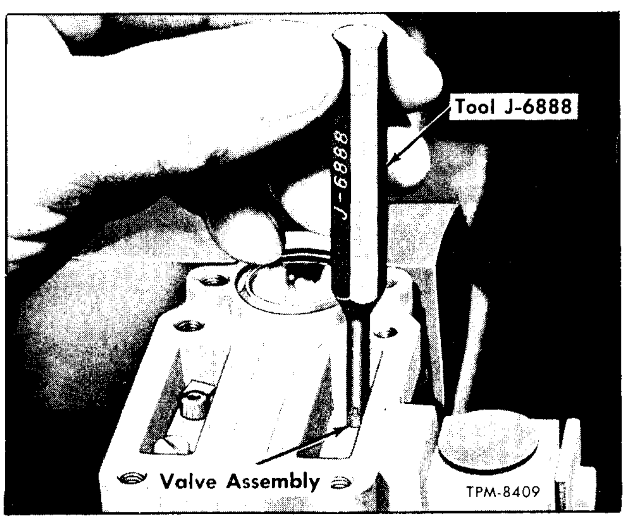


Figure 36—Replacing Valve Core Assemblies

2. Remove four cover screws and lock washers (1) from cover and bracket (2). Remove cover and bracket and two cover O-rings (6).

3. Position valve with delay plug at top. Unscrew delay plug (18) from valve body. Drain silicone fluid from cavity. Remove plug O-ring (17). Unscrew piston pin (16) from control shaft.

4. Remove two cover screws and lock washers (1) from cover (3). Remove cover and cover O-ring (4). Remove delay piston (5).

5. Remove valve lever screws and lock washers (8) from valve levers. Remove exhaust valve lever (10) and intake valve lever (12) from valve body.

6. Remove valve stem lock clip (7) from stem of exhaust valve core. Spread locking arms and slide clip from around stem.

7. Remove retaining ring (14) from overtravel control shaft. Pull overtravel assembly and shaft from valve body.

8. Remove intake valve core (13) with tool J-6888 as shown in figure 36.

9. Remove exhaust valve core (19) with tool J-6888 as shown in figure 36.

10. On front valve only, remove two retainers (43) and nylon balls (42) from exhaust valve lever cavity in body. Threaded end of piston pin (16) can be used to lift ball retainers out of body.

11. Remove plug retainer (38) from overtravel control body (35). Retainer must be cut off. Use caution to avoid damage to nylon body. Remove overtravel body plug (30).

12. Place forked end of tool J-8424 around shaft in overtravel control body, then tighten clamp screw. See figure 37. CAUTION: USE ONLY ENOUGH PRESSURE TO TAKE SPRING TENSION OFF SHAFT. Remove overtravel control shaft (28) and overtravel control body seal (34) from body. Remove shaft O-rings (26, 27, and 29). Back off

vise jaw and take body and tool from vise. Remove tool, overtravel piston (31), overtravel lever large spring (32), and overtravel lever small spring (33) from body. Remove lever screw nut (36) from overtravel lever screw or stud. Remove lever (37) from body.

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 35.

1. The following parts should be discarded and replaced with new parts at each overhaul: Plug retainer (38), overtravel control body seal (34), and O-rings (4, 6, 17, 22, 26, 27, and 29).

2. Thoroughly clean all metallic parts in a suitable cleaning solvent. Blow parts dry with compressed air.

3. Inspect all bearing and rubbing surfaces for scoring, fractures, or noticeable wear. Discard all damaged or worn parts and replace with new parts.

ASSEMBLY

NOTE: Key numbers in text refer to figure 35.

CAUTION: HEIGHT CONTROL VALVE PARTS MUST BE KEPT FREE FROM DIRT AND MOISTURE.

1. Install intake valve core (13) and exhaust valve core (19) in body with tool J-6888 in manner shown in figure 36. Tighten to 2-1/2 to 3 inch-pounds torque.

2. On front valves only, place two nylon balls (42) in passages at bottom of exhaust valve lever cavity in body. Install ball retainers (43).

3. Lubricate overtravel body with multi-purpose grease. Assemble overtravel components as follows:

a. Install overtravel lever (37) and insert overtravel lever screw (39) (early models) in body. Place lever screw nut (36) on screw and tighten to 10-15 inch-pounds torque. Tighten later type lever stud nut of 1/4 inch diameter to 70 to 80 inch-pounds torque.

b. Place overtravel lever large spring (32), and overtravel lever small spring (33) inside piston (31). Insert piston in body.

c. Place four new O-rings (26, 27, 29) on overtravel control shaft (28) as shown. Lubricate shaft and O-rings with multi-purpose grease.

d. Position fork of tool (J-8424) so that shaft can be inserted in body. Carefully apply pressure with clamp screw (fig. 37). Compress springs only enough to allow shaft to be inserted. Install overtravel control shaft (28). Rotate shaft so that flat is next to piston.

e. Insert overtravel body plug (30) in bore of body. Force new plug retainer (38) in position over nylon pivot and end plug.

f. Place new overtravel control body seal (34) on shoulder of body. Slide overtravel assembly into valve body. Insert carefully to avoid O-ring damage. Secure shaft by installing retaining ring (14).

4. Install delay assembly as follows:

a. Place delay piston (5) in valve body with open side of piston toward the overtravel shaft.

b. Align pin openings in piston and in shaft. Fit piston pin (16) in TAPERED SIDE of hole in shaft. Tighten pin to 8-10 inch-pounds torque.

5. Place intake valve lever (12) and exhaust valve lever (10) in position on overtravel shaft. Place exhaust valve lever fork around stem of valve core. Fork should be high enough on stem so that stem will not be held open. Insert valve lever screws (8) and lock washers and tighten to 8-10 inch-pounds torque.

6. Spread ends of valve stem lock clip (7) slightly and place on exhaust valve stem around stem head. Use suitable tool to brace stem, and pinch ends of clip just enough to secure on stem. Clip must rotate freely on stem.

7. Using new O-ring (22), install air inlet adapter and check valve assembly (23) into valve body.

8. At this stage of assembly, make all of the valve assembly adjustments as explained previously under "Height Control Valve Adjustments."

SHOCK ABSORBERS

DESCRIPTION

Shock absorbers used at front and at rear axles are double-acting, telescoping type. The principal components of the shock absorber, illustrated in figure 38 are: Piston and valving assembly (8), piston rod (4), rod guide and seal assembly (2), cylinder tube (7), base valving assembly (9), reservoir tube (6), shield (5), and mounting eyes (1). The cylinder tube (7) is completely filled with special hydraulic fluid, with an additional amount in the reservoir tube.

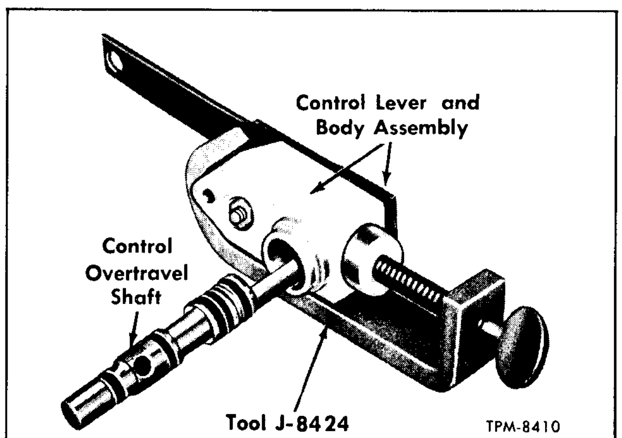
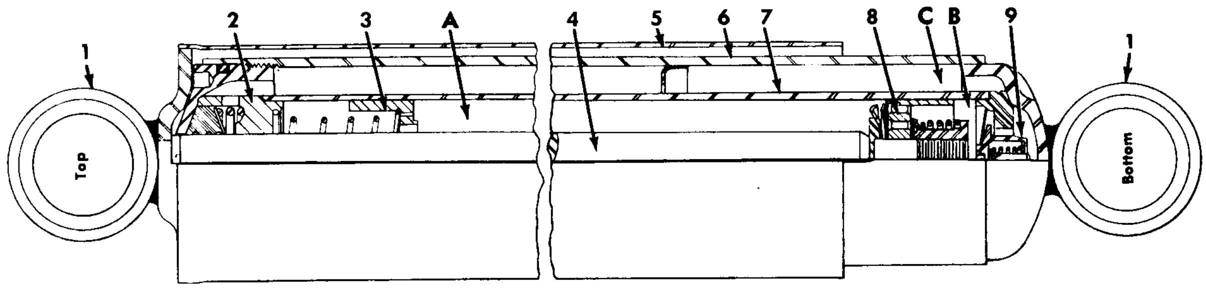


Figure 37—Replacing Overtravel Lever Shaft



1 Mounting Eye
2 Rod Guide and Seal Assy.
3 Rebound Cut-off Assy.
4 Piston Rod
5 Shield
6 Reservoir Tube
7 Cylinder Tube
8 Piston and Valving Assy.
9 Base Valving Assy. TPM-7051

Figure 38—Sectional View of Shock Absorber

Front and rear shock absorbers are identical in appearance and size, however, they are not interchangeable. Internal valving for front and rear units are different, and it is important that the correct shock absorber be used at front and rear. Part number is stamped on each unit, and reference should be made to "Specifications" at end of this section to make sure correct unit is being used.

SHOCK ABSORBER OPERATION

Starting with the shock absorber in closed position as illustrated in figure 38, the control of the opening or "rebound" stroke is as follows: As the piston assembly (8) travels upward, the fluid is compressed in the top portion (A) of the cylinder tube (7) and is forced through orifices in the piston and the rebound control valving located in the bottom of the piston. To replace fluid displaced by the piston rod (4) when in closed position, fluid is drawn from the reservoir section (C) in the reservoir tube (6) through the intake valve section of the base valve (9) into the lower portion (B) of the cylinder tube (7).

The spring and piston making up the rebound cut-off assembly (3) act as an additional cushion for the last inch of rebound stroke. When piston and valving assembly (8) reaches rebound cut-off assembly, the oil passage between piston and piston rod closes. All oil displaced during last inch of travel must flow through a small (0.073") hole in rebound cut-off piston. This restriction of oil flow results in greater dampening effect through last inch of "rebound" travel. At compression stroke, spring in rebound cut-off assembly returns piston to original position.

The closing or "compression" stroke of the shock absorber is controlled as follows: Fluid pressure for control of the compression stroke is developed entirely by the displacement of the piston rod (4) as it enters the fluid-filled cylinder tube (7). The piston (8) does not function, (as a piston) during this cycle since fluid is by-passed from section (B) to section (A) of the cylinder tube (7) through the check valve located in top of piston. The check valve opens on the compression stroke and closes on the rebound stroke.

The fluid displaced by the piston rod (4) entering the cylinder tube (7) is expelled through an orifice in the base valve (9) into the reservoir (C). However, as the velocity of movement increases, the pressure will build up faster than the orifice can bleed it out. When this pressure overcomes the force of the spring in the relief valve section of the base valve, the relief valve lifts from its seat, permitting greater flow and maintaining the internal pressure at the predetermined limit.

SHOCK ABSORBER SERVICE

Shock absorbers are of welded construction and cannot be repaired. Shock absorber not operating properly should be replaced with a new unit.

SHOCK ABSORBER REMOVAL

Remove nuts and washers from shock absorber upper and lower anchor pins. Pull shock absorber and rubber bushings off anchor pins.

SHOCK ABSORBER INSTALLATION

Refer to "Specifications" for model and valve code numbers to be sure correct unit is being installed. Make sure shock absorber mounting eyes and anchor pins are clean. Place one rubber bushing on each anchor pin, install shock absorber eyes over anchor pins, then install second rubber bushing, washer, and nut on each anchor pin. Tighten nuts to torque listed in "Specifications."

SPECIFICATIONS

AIR BELLOWS

	FRONT	REAR
Part Number (Molded on Bellows)—Goodyear	2376039	2376040
Part Number—Firestone	2427149	2426428
Diameter	6″	8″

HEIGHT CONTROL VALVES

Make .... Delco Products
Model No. (Stamped on Valve Cap)
Front 5544440
Right Rear 5549704
Left Rear 5549703

SHOCK ABSORBERS

Make .... Delco Products
Type .... Double-Acting, Telescoping

Identification (Stamped on Unit)	FRONT	REAR
Part Number	5527272	5527271
Model Number	DF480X	DF480X
Valve Code	6N20/j3	10N20/j3
Collapsed Length*	16⅞″	16⅞″
Extended Length*	26⅛″	26⅛″
Travel	9¼″	9¼″

*Length Measured from center to center of mounting eyes.

TORQUE SPECIFICATIONS

HEIGHT CONTROL VALVE

Valve Cores	2½-3 in. lbs.
Intake and Exhaust Valve Lever Screws	8-10 in. lbs.
Piston Pin	8-10 in. lbs.
Exhaust Plug	20-30 in. lbs.
Delay Plug	20-30 in. lbs.
Cover Screw	20-25 in. lbs.

FRONT SUSPENSION COMPONENTS

	Ft.-Lbs.
Lower Radius Rod Bracket to Support Stud Nut	190-210
Lower Radius Rod to Axle Bracket Cap Screw	200-225
Lower Radius Rod to Frame Bracket Bolt Nut	190-210
Upper Radius Rod to Frame Bracket Bolt Nut	190-210
Upper Radius Rod to Suspension Support Cap Screw	200-225
Lateral Rod to Frame Bracket Cap Screw	200-225
Lateral Rod to Suspension Support Cap Screw	200-225
Suspension Support "U" Bolt Nut	90-110
Adapter Plate to Bellows Retainer Jam Nut	60-80
Adapter Plate to Bellows Retainer Lock Nut	25-30
Bellows Plate Stud Nut to Suspension Support	25-30
Adapter Plate to Beam Bolt Nut	15-20
Axle Bumper Bolt Nut	20-30
Height Control Valve Bracket to Cross Member Bolt Nut	8-12
Height Control Link Nut	6-7
Shock Absorber Mounting Stud Nut	60-70

(Continued on next page.)

SPECIFICATIONS (CONT.)

REAR SUSPENSION COMPONENTS	Ft.-Lbs.
Radius Rod Bracket to Axle Housing Stud Nut	200-210
Suspension Support to Axle Bolt Nut	200-220
Lower Radius Rod to Suspension Support Cap Screw	200-225
Lower Radius Rod to Frame Bolt Nut	190-210
Upper Radius Rod to Frame Bracket	190-210
Upper Radius Rod to Axle Bracket Cap Screw	200-225
Bellows Plate Stud Nut to Suspension Support	25-30
Adapter Plate to Beam Bolt Nut	20-30
Adapter Plate to Bellows Retainer Jam Nut	60-80
Adapter Plate to Bellows Retainer Lock Nut	25-30
Stabilizer Bar Link Nut	175 Min.
Stabilizer Bar Bracket to Support Bolt Nut	20-30
Stabilizer Bar Clamp Bolt Nut	20-30
Shock Absorber Mounting Stud Nut	60-70

Steering System

This group includes maintenance information on both mechanical and power steering systems used on coaches covered by this manual. The power units used in conjunction with the conventional mechanical steering units are covered under "POWER STEERING" section later in this group. All other information applies to both systems with exceptions noted in text. This group is divided into two separate sections as shown in the following Index:

Mechanical Steering

GENERAL

Two types of steering systems are used on these coaches - Conventional Mechanical Steering as standard equipment and Power Steering as optional equipment.

The mechanical steering system (fig. 1), is composed of steering wheel, steering column and bevel gear assembly, two steering propeller shafts and support, steering gear assembly, and allied parts of the front axle.

Related front end assemblies which may affect steering operations: Air Suspension, Brakes, Wheel Bearings, Front Axle, and Front End Alignment are covered in their respective sections in this manual.

The mechanical steering gear (fig. 11) is a conventional recirculating ball bearing and sector nut type, mounted on the front axle center and connected to the steering column bevel gear unit by two propeller shafts as shown in figure 1.

When a coach is equipped with power steering, a booster cylinder assembly is added to the system at front axle. Also, a power steering pump mounted at rear of engine is added to the system. Hydraulic fluid lines connect the booster cylinder to the hydraulic pump. The power steering units are described later in the "POWER STEERING" section.

Specifications and other pertinent steering system information is given in "Specifications" at the end of each section.

CONSTRUCTION AND OPERATION

MOUNTING (Fig. 1)

Mechanical steering system installation is illustrated in figure 1. Steering column and bevel gear housing assembly is bolted to a bracket on left-hand frame longitudinal member, with steering column extending upward through floor. Steering column is supported at coach floor and dash panel by supports, plates, and brackets.

Steering gear assembly is mounted on support brackets on front axle center. Position of the gear assembly on axle center is maintained by two bolts through the gear housing flange into the front of the axle center. Support brackets are attached to axle center with U-bolts. Steering gear is mounted with Pitman shaft pointing down. Pitman arm extends rearward under axle and is connected to the drag link. Drag link is connected to steering arm at left front wheel.

Operation of steering system is essentially the same as a conventional type, except that the steering gear is mounted on front axle. Steering effort is therefore transmitted from bevel gear unit to steering gear through two steering propeller shafts. Movement of steering gear Pitman shaft is transmitted to front wheels through Pitman arm, drag link, steering knuckle arm, and tie rod.

STEERING COLUMN AND BEVEL GEAR (Fig. 2)

Steering column is composed of steering wheel, upper shaft and jacket, universal joint, lower shaft and jacket, and bevel gear.

Bevel gear housing upper cover is pressed onto and riveted to steering column tube. Steering shaft pinion gear is pressed onto steering shaft and secured with Woodruff key and lock nut. The upper pinion gear is mounted in roller needle bearings in bevel gear housing upper cover. Upper pinion gear is adjustable toward lower bevel gear by means of shims used between gear housing upper cover and bevel gear housing.

Lower bevel gear is mounted in needle bearings in bevel gear housing and housing cap assembly, and is adjustable toward steering shaft pinion gear by means of an adjusting screw. Steering pro-

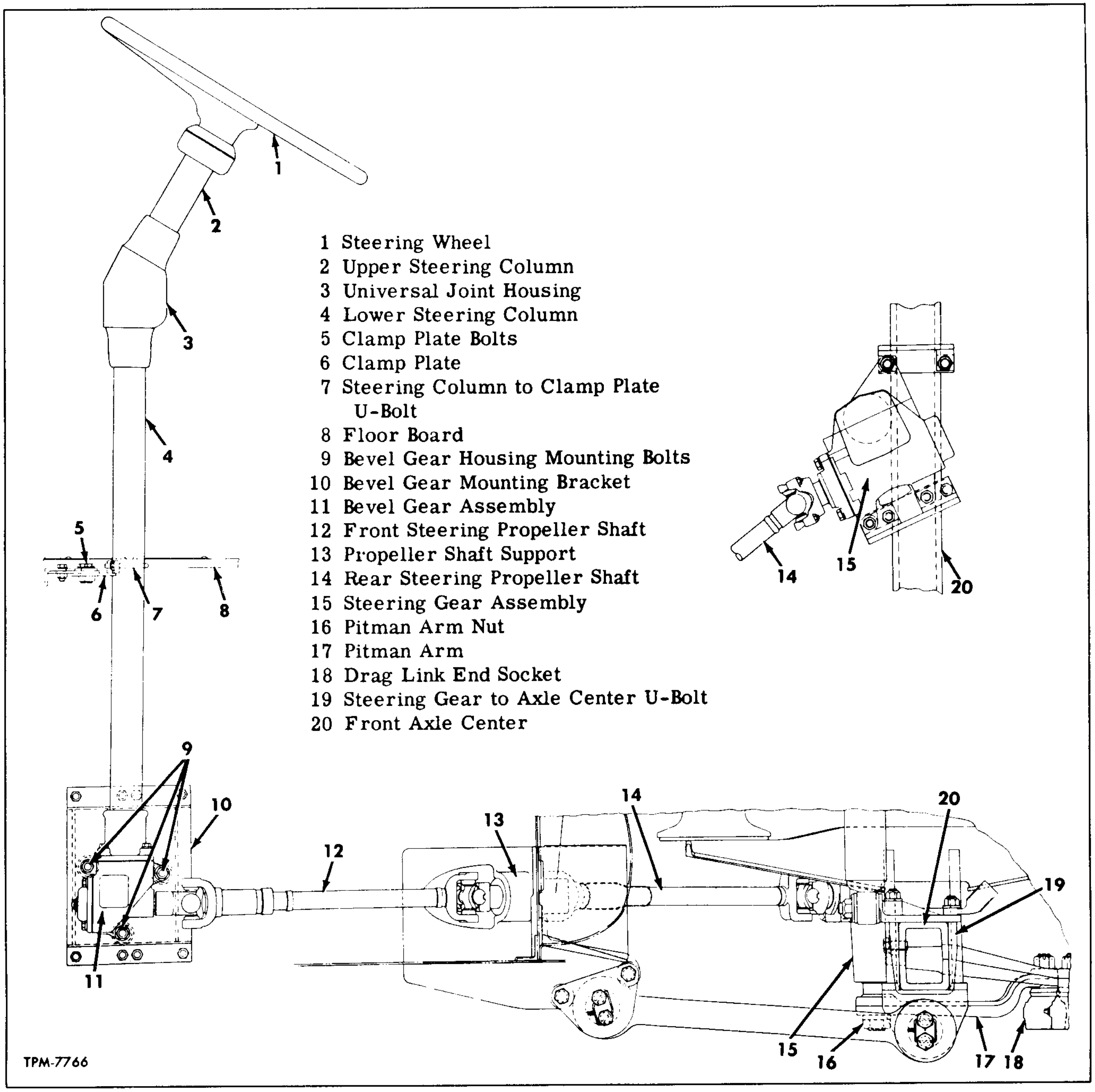


Figure 1—Mechanical Steering System

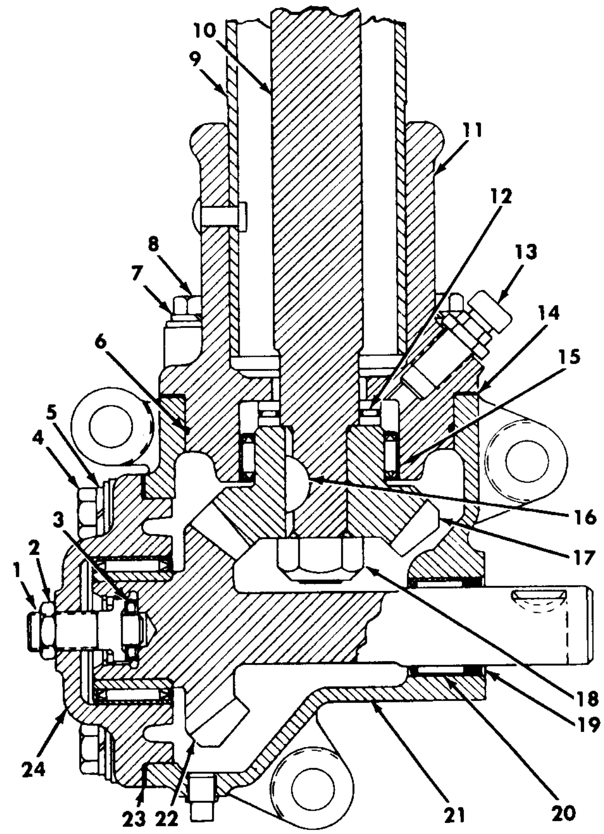
peller shaft yoke is keyed to lower bevel gear and is secured by a pinch bolt.

Steering column upper shaft is supported at upper end by a ball bearing assembly which is pressed into upper column jacket. Steering wheel is keyed to upper end of steering shaft and secured with a nut. Horn contact, spring, button, and components are mounted on upper end of shaft and in center of steering wheel as shown in figure 3. Lower end of upper shaft is attached to lower shaft by means of a universal joint assembly (fig. 6).

Steering column lower shaft is supported at upper end by a roller bearing pressed into lower column jacket. Upper end of lower shaft is attached to lower end of upper shaft by a universal joint assembly (fig. 6). Lower end of lower shaft is secured to bevel gear pinion gear by means of a Woodruff key and lock nut.

STEERING PROPELLER SHAFTS

Steering propeller shafts and propeller shaft bearing support assembly, which transmit motion



1 Bevel Gear Screw
2 Lock Nut
3 Bevel Gear Bearing
4 Cap to Housing Bolt
5 Lock Washer
6 Cover to Housing O-ring Seal
7 Lock Washer
8 Cover to Housing Bolt
9 Steering Column Tube
10 Steering Shaft
11 Housing Upper Cover
12 Steering Shaft Lower Bearing
13 Housing Vent Assembly
14 Shim Pack
15 Housing Upper Cover Bearing
16 Woodruff Key
17 Steering Shaft Pinion Gear
18 Pinion Gear to Shaft Nut
19 Retainer
20 Housing Bearing
21 Bevel Gear Housing
22 Bevel Gear
23 Cap to Housing Gasket
24 Housing Cap Assembly

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Figure 2—Steering Column Bevel Gear

from steering column to the steering gear, are shown in figure 1. Propeller shafts (fig. 9) are tubular type equipped with needle bearing type universal joints at each end, also a splined slip joint to absorb endwise movement. The propeller shaft bearing support assembly (fig. 10) is supported by a bracket riveted to coach understructure.

WORM SHAFT AND NUT (Fig. 11)

The steering worm, which is welded to worm shaft, is mounted in steering gear housing between two tapered roller bearings. Bearings are adjusted to control worm end play by means of shims used between the housing top cover and the gear housing. Helical cut groove in worm is precision finished to serve as a race for balls between worm and worm nut. Bore of worm nut is threaded with a precision finished helical groove corresponding to groove in worm. Worm nut balls are inserted in helical grooves between worm and worm nut in two separate circuits. Two tubular ball guides fit into worm nut and are clamped in place. These guides deflect worm nut balls from end of circuit in worm nut, returning them to helical path at start of circuit. Worm nut balls are the only contact between worm and nut. When worm is turned, worm ball nut moves along worm and at the same time, worm nut balls roll freely between worm and nut, circulating within their separate circuits. This arrangement provides a rolling instead of a sliding contact between parts.

Rack teeth on one side of worm nut mesh with teeth on Pitman shaft; thus, endwise movement of worm nut causes Pitman shaft to rotate.

Shaft yoke is keyed to propeller shaft end of worm and secured with a pinch bolt. An oil seal is pressed into gear housing. Seal wipes on shaft yoke hub.

PITMAN SHAFT (Fig. 11)

Teeth on Pitman shaft are not the ordinary spur gear type, but are specially designed to provide true rack and sector gear action when worm nut is positioned at a slight angle. This construction permits simple lash adjustment by shifting the Pitman shaft along its axis by means of the lash adjuster screw. With Pitman shaft adjusted to eliminate all lash at straight-ahead position, sector teeth design provides a slight lash when wheels are turned far to right or left. This design permits

adjustment for wear of sector teeth in straight-ahead position without causing binding of teeth in less used portion of sector (extreme left or right position).

Pitman shaft is mounted on three needle type roller bearing assemblies, two in gear housing and one in housing side cover. An oil seal is pressed into housing at Pitman arm end of Pitman shaft.

MAINTENANCE

The following light maintenance operations include inspection and adjustment items which may be accomplished without removing the steering gear from the vehicle.

1. At regular intervals, check and if necessary, tighten all steering gear mounting bolts, bevel gear housing mounting bolts, propeller shaft yoke bolts, Pitman arm retaining nut, drag link to Pitman arm and steering arm retaining nuts, tie rod to steering arm retaining nuts, and all assembly bolts on steering gear and bevel gear housing.

2. Check steering gear adjustments and adjust if necessary. Refer to "Steering Gear Adjustments" later in this section.

3. Check front end alignment: Refer to "FRONT END ALIGNMENT" (SEC. 1) of this manual.

4. Lubricate steering gear and allied units at regular intervals, as indicated in LUBRICATION (SEC. 13) of this manual.

STEERING GEAR ADJUSTMENTS

Before an attempt is made to remedy steering difficulties by adjusting the steering gear, other factors which might cause hard or otherwise unsatisfactory steering should be checked. Particular attention should be given to tire inflation, lubrication, wheel bearings, brakes, air suspension, front end alignment, and worn, bent, or broken front axle parts.

It is important that steering gear be properly adjusted to assure satisfactory steering and to prevent excessive wear of parts. Adjustments are provided for worm bearing end play and Pitman shaft lash.

Always check worm bearing adjustment, and adjust if necessary, prior to making Pitman shaft lash adjustment.

Before making adjustments, the following preliminary operations are necessary:

1. Disconnect steering drag link from steering gear Pitman arm by removing nut from end stud and driving end stud out of arm. Drag link should remain disconnected until all steering gear adjustments are completed.

2. Disconnect propeller shaft universal joint yoke from yoke on steering gear worm shaft by removing U-bolts and lock nuts. Obtain a bar which can be bolted to worm yoke, with a hole in bar 9 inches from center of worm.

WORM BEARING CHECK AND ADJUSTMENT

Key numbers in text refer to figure 11.

1. Loosen lash adjuster lock nut (2) and turn lash adjuster screw (1) counterclockwise a few turns. This relieves load imposed on worm bearings by close meshing of teeth on worm nut and Pitman shaft sector gear.

2. Gently turn worm to either extreme left or right position; then back away about one turn.

IMPORTANT: Do not turn worm hard to end of travel with linkage disconnected or ball guides on worm nut may be damaged.

3. Bolt bar previously obtained to worm shaft yoke (35), and attach spring scale (J-544-01) to bar 9 inches from center of worm. Pulling on spring scale at right angle to bar, measure pull required to keep worm in motion. Pull required must be within 1-1/2 to 2 pounds, otherwise worm bearing adjustment is required.

NOTE: If any "rough" or "lumpy" action is noted during check, worm bearings are damaged. Steering gear should then be removed, disassembled, and bearings replaced as described later in this section under "Steering Gear Overhaul."

4. Remove top cover bolts and remove housing top cover (25). Remove as many shims from between top cover and housing as required to eliminate all worm end play, when cover is reinstalled and bolts fully tightened. Shims used are 0.002", 0.005", 0.010", and 0.030" thick. A minimum of three 0.002" thick and two 0.005" thick shims should be used.

5. Again check pull as in Step 3 above, and readjust, if necessary, to obtain proper pull. If adjustment is correct, adjust Pitman shaft lash as described in the following:

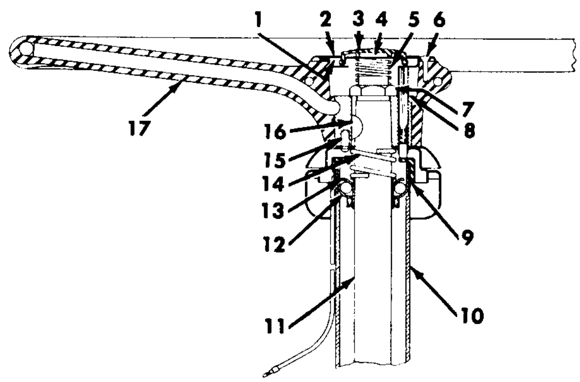
PITMAN SHAFT LASH ADJUSTMENT (Fig. 11)

NOTE: Worm bearing adjustment must be completed before making Pitman shaft lash adjustment.

1. Center steering gear by turning worm shaft from extreme right to extreme left position, counting exact number of turns; then rotate worm back exactly half-way. Mark worm yoke with Prussian blue to indicate center position.

2. Tighten side cover bolts (3) to 25-35 foot-pounds torque. Turn lash adjuster screw (1) clockwise sufficiently to remove all lash between worm nut teeth and teeth on Pitman shaft sector. Amount of lash may be felt by pushing Pitman arm back and forth. When all lash has been removed, tighten lash adjuster lock nut (2) to 25-35 foot-pounds torque.

3. Check adjustment with spring scale as in Step 3 under "Worm Bearing Check and Adjust-



1 Horn Button Insulator
2 Horn Button Retainer
3 Horn Button
4 Horn Button Plate
5 Horn Button Spring
6 Retainer Screw
7 Steering Wheel Retaining Nut
8 Connector, Sleeve, and Brush Assy.
9 Contact and Cable Assy.
10 Steering Column Upper Tube
11 Steering Upper Shaft
12 Steering Shaft Upper Bearing
13 Spring Seat
14 Bearing Spring
15 Stud
16 Woodruff Key
17 Steering Wheel

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Figure 3—Steering Wheel and Horn Contact

ment," except measure greatest pull at CENTER position. If necessary, readjust to obtain pull within 2-3/4 to 3-1/4 pounds.

4. Connect drag link to Pitman shaft, adjusting drag link length, if necessary, as directed under "Drag Link " later in this section.

5. Connect propeller shaft universal joint yoke to yoke on worm shaft.

STEERING WHEEL REPLACEMENT

REMOVAL (Figs. 3 and 4)

Key numbers in text refer to figure 3.

1. Remove three screws (6) which attach horn button retainer (2) to steering wheel (17). Remove retainer (2), insulator (1), horn button (3), terminal plate (4), and spring (5) from wheel. Lift connector assembly (8), consisting of contact plate, sleeve, springs, and brush out of wheel.

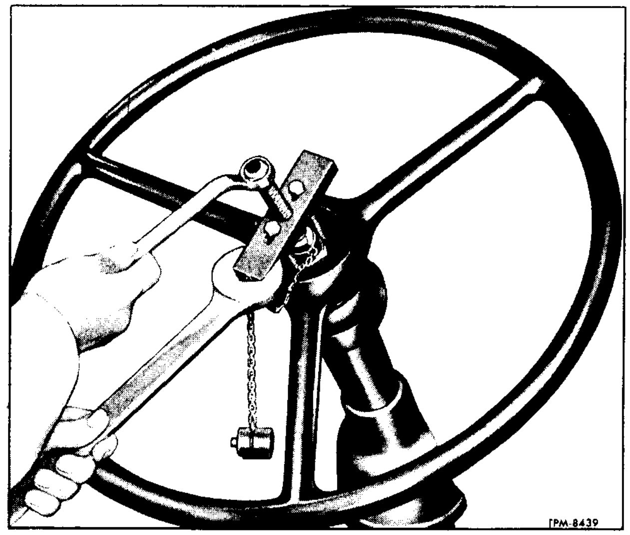


Figure 4—Removing Steering Wheel

2. Remove steering wheel retaining nut (7).

3. Puller screw holes are provided in wheel hub. Using steering wheel puller (J-2927-01) and two puller screws with 17/64" diameter, pull steering wheel off shaft (fig. 4).

INSTALLATION

1. If removed, tap Woodruff key (16) into keyseat in shaft. Make sure directional signal switch shield is in place on bottom of wheel hub. Position wheel on shaft, with Woodruff key engaging keyway in wheel hub. Install steering wheel retaining nut on shaft. Tighten nut to 40-50 foot-pounds torque.

2. Install connector assembly, consisting of contact plate, sleeve, spring, and brush in steering wheel hub, making sure sleeve enters hole in contact shield.

3. Install spring, terminal plate, horn button, insulator, and horn button retainer on wheel and attach with three screws.

STEERING COLUMN AND BEVEL GEAR

STEERING COLUMN REPLACEMENT

Whenever steering column and bevel gear assembly requires service which requires disassembly, the entire assembly can readily be removed from the coach.

REMOVAL (Fig. 1)

1. Remove directional signal switch assembly from steering column.

2. Remove six metal screws attaching closure plates to coach floor. Remove front and rear closure plates.

3. Remove two lock nuts from steering column support U-bolt under coach floor. Remove U-bolt.

4. Open door at left front corner of coach to gain access to steering lower column and bevel gear assembly.

5. Lift latch and raise steering propeller shaft shield.

6. Remove lock nuts and two U-bolts attaching propeller shaft universal joint yoke to yoke on

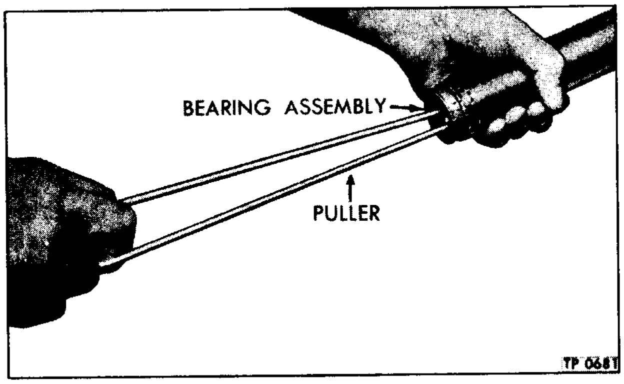
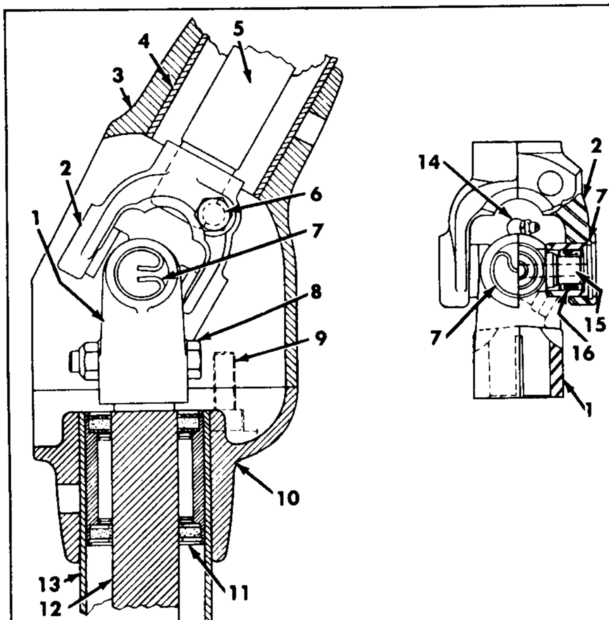


Figure 5—Removing Upper Steering Shaft Bearing

lower column bevel gear. Move universal joint to the rear.

7. Remove nuts and washers from three bolts attaching bevel gear housing to mounting bracket on frame longitudinal member. NOTE: Heads of the mounting bolts are accessible through button



1 Lower End Yoke
2 Upper End Yoke
3 Upper Housing
4 Upper Column Jacket
5 Steering Column Upper Shaft
6 Universal Joint Upper Bolt
7 Snap Ring
8 Universal Joint Lower Bolt
9 Lower to Upper Housing Bolt
10 Lower Housing
11 Lower Column Upper Bearing
12 Steering Column Lower Shaft
13 Lower Column Jacket
14 Lubrication Fitting
15 Journal Assembly
16 Universal Joint Bearing

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Figure 6—Steering Column Universal Joint

plug openings inside tire carrier compartment.

8. Lift steering column and bevel gear assembly straight up and out of coach.

INSTALLATION (Fig. 1)

1. Insert steering column and bevel gear assembly downward through opening in coach floor.

2. Position bevel gear housing to mounting bracket and install three bolts, nuts, and washers. Do not tighten bolts.

3. Loosen two bolts attaching clamp plate to support; then tighten bevel gear housing to bracket attaching bolts. Tighten bolts to 35-45 foot-pounds torque.

4. Tighten the two clamp plate to support bolts, that were previously loosened in step 3 above, to 30-35 foot-pounds torque.

5. Install steering column support U-bolt to clamp plate. Tighten lock nuts to 5-7 foot-pounds torque.

6. Connect steering propeller shaft yoke to yoke on bevel gear shaft with two U-bolts and lock nuts. Tighten lock nuts to 15-22 foot-pounds torque.

7. Position front and rear closure plates around steering column on coach floor; then install six metal screws attaching plates to floor.

8. Install directional signal switch on steering column jacket.

STEERING COLUMN AND BEVEL GEAR OVERHAUL

(Refer to Figures 1, 2, 3 and 6)

DISASSEMBLY OF STEERING UPPER COLUMN

1. Remove steering wheel as previously described under "Steering Wheel Replacement."

2. Remove four cap screws attaching steering column upper and lower universal joint housings. Lift upper column jacket and housing assembly from lower housing and upper shaft.

3. Remove Woodruff key, upper bearing spring, and spring seat from upper shaft.

4. Remove horn contact and cable assembly from upper column jacket.

5. Using bearing puller (J-489), remove upper column upper bearing (fig. 5).

6. Remove two clamp bolts and lock nuts and remove steering column universal joint assembly from upper and lower steering column shafts.

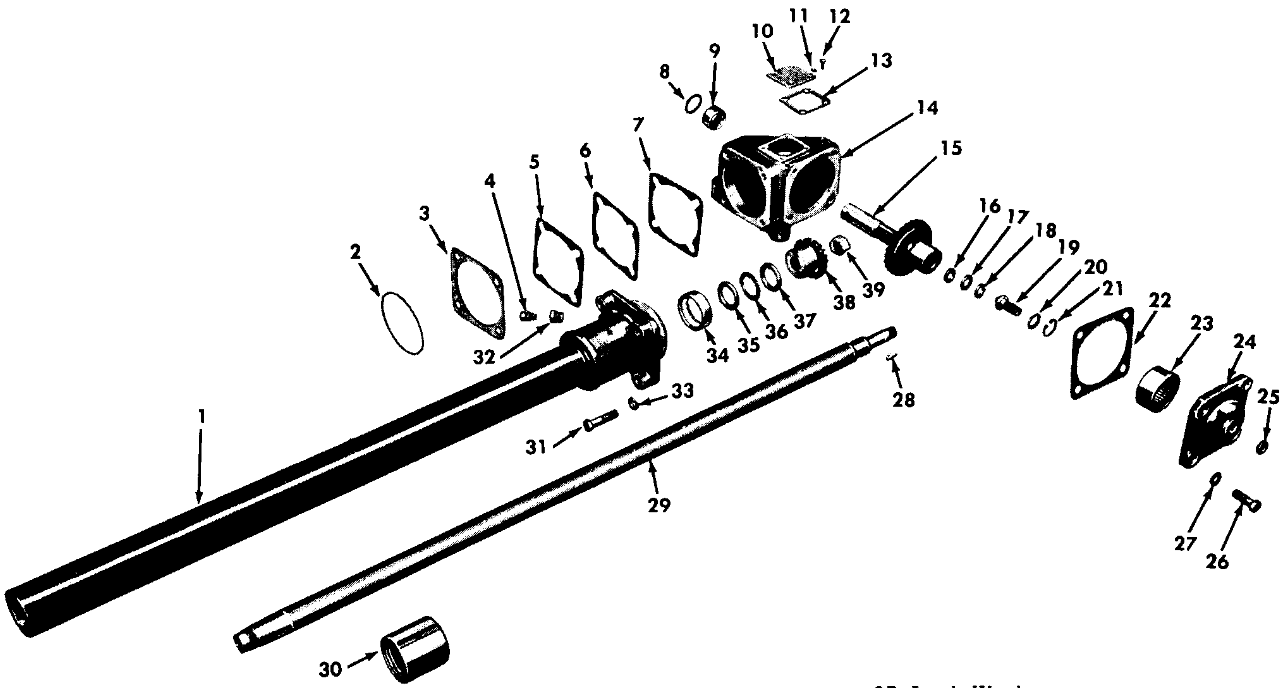
DISASSEMBLY OF STEERING COLUMN UNIVERSAL JOINT (Fig. 6)

1. Remove four bearing retainer snap rings.

2. Using a soft hammer, drive journal assembly sideways and drive one bearing out of yoke.

3. Turn the assembly over and drive journal in opposite direction to remove second bearing from yoke. Separate end yokes.

NOTE: Rollers will drop out of bearings. Use



1 Column Lower Jacket and Bevel Gear Housing Upper Cover Assembly	13 Gasket	27 Lock Washer
2 Jacket to Housing O-ring Seal	14 Bevel Gear Housing	28 Woodruff Key
3 Gasket	15 Bevel Gear	29 Steering Column Lower Shaft
4 Housing Vent	16 Bearing Race	30 Lower Shaft Upper Bearing
5 Thick Shim	17 Bevel Gear Bearing	31 Cover to Housing Bolt
6 Thin Shim	18 Bearing Race	32 Vent to Housing Bushing
7 Thick Shim	19 Bevel Gear Adjusting Screw	33 Lock Washer
8 Retainer	20 Washer	34 Housing Upper Cover Bearing Assembly
9 Bearing	21 Bearing Retainer Ring	35 Bearing Race
10 Cover Plate	22 Gasket	36 Steering Shaft Lower Bearing
11 Lock Washer	23 Housing Cap Bearing Assembly	37 Bearing Race
12 Screw	24 Bevel Gear Housing Cap	38 Steering Shaft Pinion Gear
	25 Bevel Gear Nut	39 Pinion Gear to Shaft Nut
	26 Cap to Housing Bolt	

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Figure 7—Lower Column and Bevel Gear Components

care to prevent damage to, or loss of bearing rollers.

4. Repeat procedures outlined in steps 2 and 3 above to remove two remaining bearings and journal assembly from end yoke.

DISASSEMBLY OF STEERING LOWER COLUMN AND BEVEL GEAR

Key numbers in text refer to figure 7.

1. Remove four bolts and lock washers attaching steering column jacket and bevel gear housing upper cover assembly (1) to bevel gear housing (14). Lift jacket and cover assembly from bevel gear housing. Save shims (5, 6, and 7) used between cover and housing for reuse at assembly. Discard gasket (3).

2. Remove O-ring seal (2) from groove in upper cover (1). Discard seal.

3. While holding steering shaft (29) in a vise with soft jaws, remove pinion gear retaining nut (39) from end of steering shaft (29).

4. Using a brass drift and hammer, tap steering shaft (29) out of pinion gear (38). Remove gear, lower bearing (36), and two bearing races (35 and 37).

5. Remove steering shaft (29) from steering column jacket (1).

6. Remove steering shaft upper bearing (30) from jacket (1), using puller (J-489). Refer to figure 5.

7. With a suitable puller and slide hammer, remove the bearing assembly (34) from bevel gear upper cover (1) (fig. 8).

8. Remove housing vent assembly (4) and reducing bushing (32) from upper cover (1).

9. Remove four bolts and lock washers, then

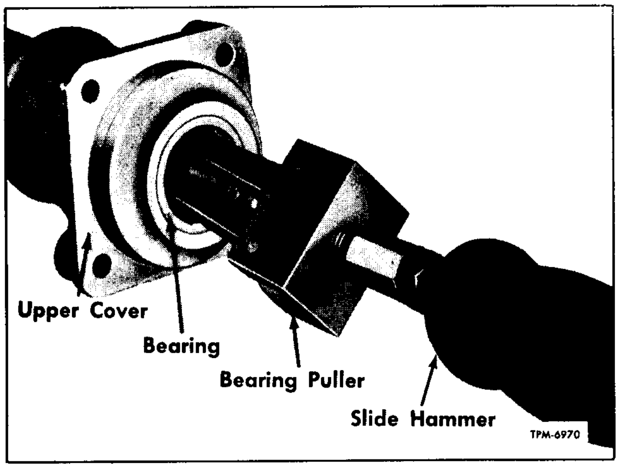


Figure 8—Removing Bearing From Upper Cover

remove housing cap (24) and bevel gear assembly (15) from bevel gear housing (14). Remove and discard gasket (22).

10. Remove lock nut (25); then using an Allen end wrench, remove adjusting screw (19) and bevel gear assembly (15) from housing cap (24).

11. Remove snap ring (21) from bevel gear shaft (15).

12. Remove adjusting screw (19), washer (20), outer and inner race (16 and 18), and bearing (17) from bevel gear shaft (15).

13. Remove bearing race from bevel gear (15) only if inspection shows necessity.

14. Using an arbor press and suitable remover tool, remove retainer seal (8) and bearing (9) from bevel gear housing (14).

15. Remove four screws (12) and lock washers, then remove cover plate (10) and gasket (13) from bevel gear housing (14). Discard gasket.

16. Remove drain plug from bevel gear housing (14).

17. Do not remove bearing (23) from housing cap (24) unless inspection shows necessity for removal.

CLEANING AND INSPECTION

Cleaning

Immerse all parts in cleaning solvent to loosen deposits of dirt or old lubricant. Repeat immersion and brushing with soft bristle brush until all parts are thoroughly clean. Remove any particles of old gaskets remaining on bolting surfaces of housings.

Inspection

1. Inspect steering shafts and jackets for bent or twisted condition. Check shafts for defective splines and keyways.

2. Examine bevel gear and pinion gear for worn, chipped, or broken teeth, also for damaged splines. Replace with new parts if defective.

3. Inspect all bearings for worn or damaged condition, such as flat spots on balls or rollers and damaged races. Replace with new parts if damaged.

4. Inspect bevel gear flange and oil seal lip for roughness at seal contact area on flange. Flange can sometimes be cleaned up with fine emery cloth, otherwise replace with new part.

5. Check needle bearings on universal joint, outer race, and journal for wear or damage. Pack bearing one-third full of grease to retain rollers, then install on journal to check fit on journal. If excessive clearance is evident, replace bearings or journal as necessary.

6. Always use new gaskets, oil seals, and snap rings when assembling the steering column and bevel gear assembly.

ASSEMBLY OF STEERING LOWER COLUMN AND BEVEL GEAR

Key numbers in text refer to figure 7.

1. Using an arbor press and suitable sleeve, press bearing assembly (23) into bore of bevel gear housing cap (24) if bearing was previously removed.

2. With press and suitable sleeve, press bearing assembly (9) and retainer seal (8) into bore of bevel gear housing (14).

3. Install drain plug in bore of bevel gear housing (14).

4. If bearing race was removed from bevel gear shaft (15) during inspection procedures, press new race on shaft.

5. Position bevel gear in vise with soft jaws and install inner race (16), bearing (17), outer race (18), adjusting screw (19), washer (20), and snap ring (21) in bore of bevel gear shaft (15).

6. Position housing cap assembly (24) on end of bevel gear (15); then using an Allen end wrench, turn cap on shaft. Install lock nut (25) on bevel gear adjusting screw (19) loosely. Nut is to be tightened later in step 17.

7. Place new gasket (22) over bevel gear (15) and against housing cap (24); then install bevel gear and cap assembly in bevel gear housing, attaching with four bolts and lock washers. Tighten bolts to 20-25 foot-pounds torque. NOTE: Side of cap with corners cut off goes toward bottom of housing.

8. Install Woodruff key (28) in slot in lower end of steering shaft (29).

9. With suitable sleeve and hammer, tap bearing assembly (34) into housing upper cover (1).

10. Insert steering shaft (29) through top of column jacket (1) and install bearing race (35), bearing (36), and second race (37) over steering shaft and into bore of housing upper c⌐ ⌐.

11. Using a plastic hammer, tap steering shaft pinion gear (38) on lower end of steering shaft. Install retaining nut (39) on shaft. Tighten nut to 40-50 foot-pounds torque.

12. Install reducing bushing (32) and vent assembly (4) in bore of housing upper cover (1).

13. Press or tap upper bearing assembly (30) into lower steering column jacket over steering shaft.

14. Install new O-ring seal (2) in groove of upper cover (1) and position original pack of shims (5, 6, and 7) against the cover.

NOTE: Approximately two thick shims and one thin shim are required to maintain proper adjustment. Thin shims must be placed between thick shims. Shims are 0.003" and 0.010" thick.

15. To adjust backlash, remove or add shims between housing and upper cover. Removing shims will decrease backlash, while adding shims will increase backlash. Proper adjustment provides for smooth rotation of gears without binding and a minimum of backlash.

16. Install bevel gear housing assembly on lower steering column and upper cover assembly, attaching with four bolts and lock washers. Tighten bolts to 25-30 foot-pounds torque.

17. Check backlash of bevel gears. Maximum allowable backlash is 0.002". Revolve gears to make sure there is no perceptible bind at any point. If gears are meshed too tight, hard steering will result. If gears are too loose, operation will be rough and noisy with excessive steering wheel play. To adjust gear lash, thread bevel gear adjuster screw (19), in or out as necessary to obtain proper gear lash; tighten lock nut (25) securely.

18. Install new gasket (13) and cover plate (10) on bevel gear housing, attaching with four screws and lock washers. Tighten screws firmly.

ASSEMBLY OF STEERING COLUMN UNIVERSAL JOINT (Fig. 6)

1. Position journal arms in one of the end yokes; then press a bearing assembly on journal arm. Install snap ring to retain bearing.

2. Repeat step one to install bearing assembly on opposite journal arm.

3. Position journal arms in the remaining end yoke and repeat steps 1 and 2 to install remaining bearings and snap rings.

ASSEMBLY OF STEERING UPPER COLUMN

Refer to figures 1, 2, and 3.

1. Install Woodruff keys in slot of upper end of lower shaft and lower end of upper shaft.

2. Position steering column universal joint on upper and lower steering shafts.

3. Install clamp bolts and lock nuts. Tighten nuts to 20-25 foot-pounds torque.

4. Lubricate steering column universal joint assembly as described in LUBRICATION (SEC. 13) of this manual.

5. Position upper steering column on lower column and bevel gear assembly; then install four attaching cap screws. Tighten screws to 20-25 foot-pounds torque.

6. Lubricate upper steering column bearing as described in LUBRICATION (SEC. 13) of this manual; then press bearing onto upper shaft and into column jacket. Press in until outer race seats on top of column jacket.

7. Install seat spring and bearing spring on upper steering shaft.

8. Coat rubber with brake fluid; then install horn contact and cable assembly on upper column.

9. Install steering wheel and horn parts as previously described under "Steering Wheel Replacement."

STEERING PROPELLER SHAFTS

REPLACEMENT

Steering propeller shafts and center bearing support assembly, which transmit motion between steering column bevel gear and steering gear, are illustrated in figure 1. Propeller shafts (fig. 9) are tubular type equipped with needle bearing type universal joints at each end, also a splined slip joint to absorb endwise movement. Center bearing support assembly (fig. 10) is supported by a bracket riveted into body understructure.

REMOVAL

Front Propeller Shaft

1. Remove lock nuts and U-bolts attaching front propeller shaft to yoke on center bearing support. Remove shaft from support.

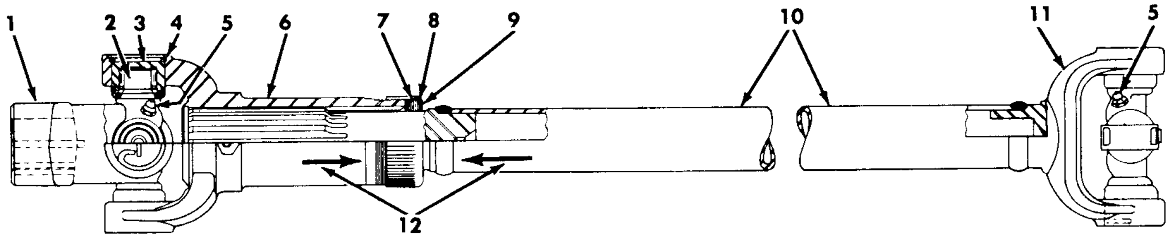
2. Remove pinch bolt and lock nut attaching front propeller shaft end yoke to steering column bevel gear shaft.

3. Tap propeller shaft loose from bevel gear shaft with a soft hammer. Remove propeller shaft.

Rear Propeller Shaft

1. Remove lock nuts and U-bolts attaching rear propeller shaft to end yoke on center bearing support.

2. Remove lock nuts and U-bolts attaching rear propeller shaft to end yoke on steering gear worm shaft.



1 End Yoke
2 Journal Cross
3 Bearing
4 Snap Ring
5 Lubrication Fitting
6 Slip Joint Sleeve Yoke
7 Cork Washer
8 Steel Washer
9 Dust Cap
10 Propeller Shaft Tube
11 Fixed Joint
12 Arrows Must Be In Line - They Align Trunnions

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Figure 9—Steering Propeller Shaft (Front Shaft Shown)

INSTALLATION

Front Propeller Shaft

1. Position front propeller shaft end yoke against yoke on center bearing support. NOTE: Slip joint end of shaft goes toward front of coach.
2. Install attaching U-bolts and lock nuts. Tighten nuts to 15-20 foot-pounds torque.
3. Position end yoke on propeller shaft on steering column bevel gear shaft. Make sure Woodruff key is properly installed in slot of bevel gear shaft.
4. Install pinch bolt and lock nut. Tighten nut to 15-20 foot-pounds torque.

Rear Propeller Shaft

1. Position rear propeller shaft end yoke to yoke on center bearing support. NOTE: Slip joint end of shaft goes toward front of coach.
2. Install attaching U-bolts and lock nuts. Tighten nuts to 15-20 foot-pounds torque.
3. Position end yoke on opposite end of shaft against end yoke on steering gear worm shaft.
4. Install attaching U-bolts and lock nuts. Tighten lock nuts to 15-20 foot-pounds torque.

STEERING PROPELLER SHAFT OVERHAUL

DISASSEMBLY

Key numbers in text refer to figure 9.

NOTE: Overhaul procedures for the front and rear steering propeller shafts are the same for both shafts.

1. Before disassembling the propeller shaft, look for alignment arrows (12) on shaft and slip joint sleeve. If arrows are not readily discernible, mark both parts so they can be reassembled in exactly the same positions.
2. Unscrew dust cap (9) from slip joint sleeve and pull slip joint assembly (6) off shaft (10). Remove steel washer (8) and cork washer (7) from dust cap (9).

NOTE: Succeeding procedures cover disassembly of universal joint at either slip joint or fixed end of shaft.

3. Remove snap rings (4) retaining bearings in end yokes.
4. Using a soft hammer, tap journal cross (2) sideways and push one bearing (3) out of yoke.
5. Turn shaft over and drive journal (2) in opposite direction to remove the second bearing. Repeat these procedures to remove remaining bearings. Remove journals from yokes.

NOTE: Rollers will drop out of bearings. Use care to prevent loss of or damage to rollers.

CLEANING AND INSPECTION

1. Clean all parts in suitable cleaning solvent. Make sure lubricant passages in journals are clean. Soak needle bearing assemblies in cleaning solvent to loosen old lubricant. Clean parts with stiff bristled brush and blow dry with compressed air.
2. Inspect bearing surfaces of journals for roughness. If journals will not clean up with moderate honing, journal should be replaced. When new journal is used, new bearings should also be used. Carefully inspect each bearing assembly for damage or missing rollers. Excessive wear is indicated if rollers drop out of retainer, or if journal bearing surfaces show marks of rollers.
3. After bearings are clean, pack with lubricant recommended in LUBRICATION (SEC 13) of this manual. Place bearings on journal and check for wear (looseness). If excessive clearance is indicated, replace journal or bearings, or both.

ASSEMBLY

1. Install lubrication fittings (5) if previously removed.

2. Insert one end of a journal into yoke as far as possible from inside; then tilt journal until opposite side of journal will drop into other side of yoke. Install journal in other yoke in same manner.

3. Install bearings (3) in yokes over ends of journal, tapping bearings into place with a rawhide or plastic hammer if necessary. Install new snap rings (4) to secure bearings in yokes. Make sure snap rings are fully seated in grooves.

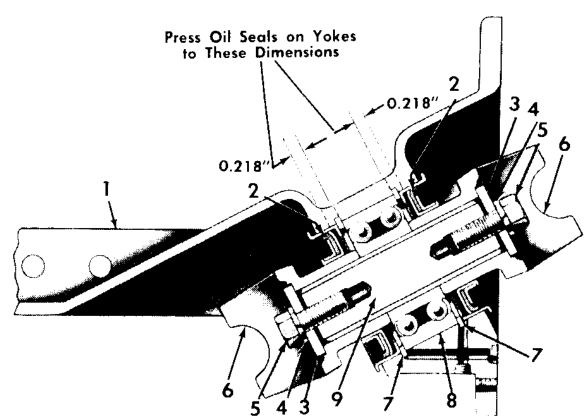
4. Repeat these procedures to install journal and bearing at opposite end of shaft.

5. Install steel washer (8) and new cork washer (7) in dust cap (9) on slip joint end of shaft.

6. Insert shaft (10) into slip joint sleeve, being sure arrows (12) or marks made prior to disassembly are aligned. Thread dust cap onto slip joint sleeve and tighten with hand.

STEERING PROPELLER SHAFT SUPPORT

Front and rear steering propeller shafts are connected and supported by the center bearing support assembly which is attached to coach understructure (fig. 10).



1 Support
2 Oil Seal Assembly
3 Flat Washer
4 Lock Washer
5 Retaining Bolt
6 End Yoke
7 Bearing Retainer
8 Bearing Assembly
9 Stub Shaft

Figure 10—Steering Propeller Shaft Support

DISASSEMBLY

1. Disconnect rear end of front propeller shaft and front end of rear propeller shaft as directed previously in this section.

2. Remove yoke retaining screw (5), lock washer (4), and flat washer (3) from either yoke. Use suitable puller to pull yoke (6) and seal assembly (2) from stub shaft (9).

3. Push stub shaft (9) and remaining yoke assembly out of support and bearing. Mount stub shaft (9) in vise having soft jaw plates and remove remaining yoke screw and washers; then pull yoke from shaft.

4. Press oil seal assembly (2) from each yoke. Remove two bearing retainers (7) from support; then remove bearing (8).

CLEANING AND INSPECTION

1. Immerse all parts in suitable cleaning solvent to loosen and remove all deposits and accumulations of dirt and old lubricant. Remove lubrication fitting and pipe plug from support; then clean lubricant passages and inside of support.

2. Rotate the bearing assembly slowly while examining for rough balls, flat spots, chips, or other damage. Replace bearing if not in good condition.

3. After the bearing has been cleaned and inspected, lubricate bearing and wrap in a clean cloth until ready for installation.

4. Replace all parts that are not in good condition.

ASSEMBLY

1. Install one bearing retainer (7) into groove in propeller shaft center bearing support (1).

2. Install bearing (8) in support; then install opposite bearing retainer (7). Carefully check both bearing retainers to be sure they are fully seated in their grooves.

3. Press new oil seal (2) assembly onto each end yoke (6) to dimension shown in figure 10.

4. Install one yoke and seal assembly onto stub shaft (9) and secure with flat washer (3), lock washer (4), and retaining bolt (5).

5. Apply a liberal coating of grease to lip of oil seals. Install stub shaft (9) and yoke assembly into support and bearing; then install remaining yoke and oil seal assembly. Install yoke retaining flat washer, lock washer, and retaining bolt; then tighten both yoke retaining bolts (7).

6. Install lubrication fitting in support and apply lubricant recommended in LUBRICATION (SEC. 13) until it appears at lip of seal, indicating that bearing is thoroughly lubricated.

7. Connect front and rear steering propeller shafts to center bearing support yokes as directed previously in this section.

STEERING GEAR

STEERING GEAR REPLACEMENT

REMOVAL (Fig. 1)

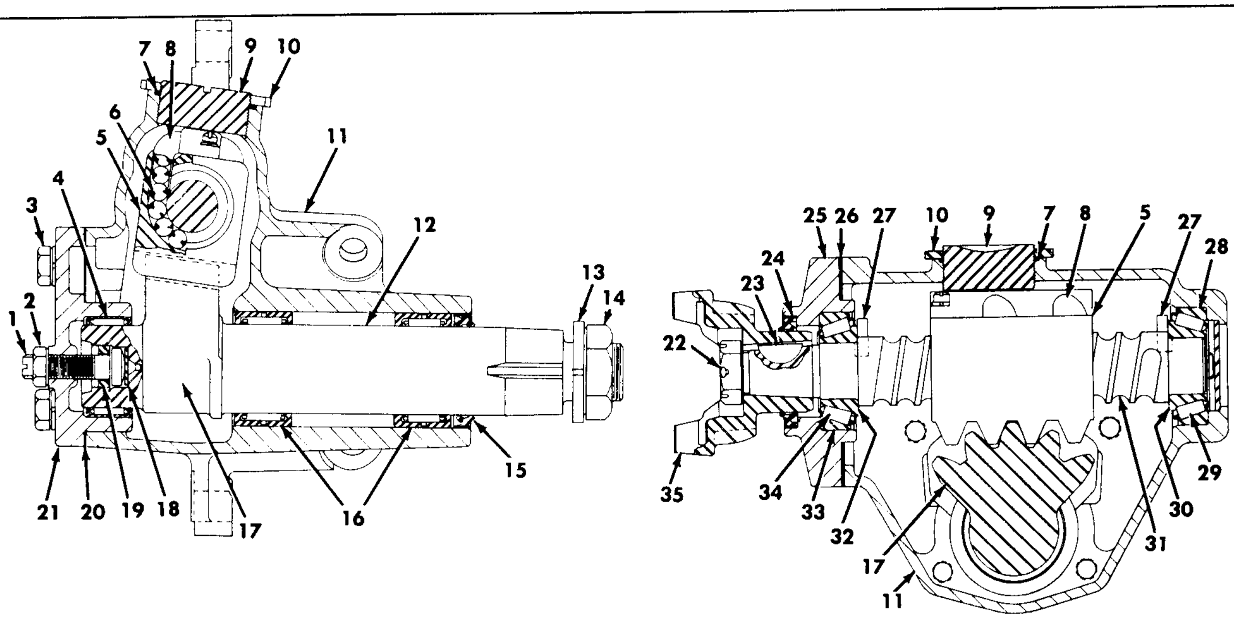
1. Disconnect propeller shaft universal joint yoke from yoke on steering gear worm shaft.
2. Disconnect the drag link from Pitman arm; then remove Pitman arm retaining nut and lock washer. Pull Pitman arm off shaft, using puller (J-3186) or other suitable puller.
3. Remove forward nut and lock washer from right-hand support U-bolt. Remove nuts and lock washers from two left-hand support studs. Remove two bolts and lock washers located in gear housing flange at forward side of the axle center.
4. Lift steering gear assembly up off studs and move forward off axle.

INSTALLATION (Fig. 1)

1. Position steering gear assembly on front axle, with two left-hand support studs and front end of right-hand support U-bolt engaging holes in steering gear housing flanges.
2. Install nuts and lock washers on studs and U-bolt. Install two gear housing to axle bolts in gear housing flange at front side of axle. Tighten to torque listed in "Specifications."
3. With front wheels in straight-ahead position, install Pitman arm on Pitman shaft so centerline of hole at drag link end of arm is 0.50" to left of centerline of coach (with power steering), or 1.26" to right of centerline of coach (with mechanical steering).

NOTE: Centerline of coach can be identified by prick punch marks on rear side of front axle.

4. Install lock washer and nut on Pitman shaft to secure Pitman arm. Tighten nut to 250-300 foot-pounds torque.
5. Position end stud on drag link in hole in



1 Lash Adjuster Screw
2 Lock Nut
3 Side Cover Bolt
4 Pitman Shaft Side Cover Bearing
5 Worm Ball Nut
6 Worm Balls
7 Back-up Adjuster Packing
8 Ball Guide
9 Back-up Adjuster
10 Back-up Adjuster Lock Nut
11 Steering Gear Housing
12 Pitman Shaft
13 Lock Washer
14 Pitman Arm Nut
15 Pitman Shaft Oil Seal
16 Pitman Shaft Housing Bearings
17 Pitman Shaft Sector Gear
18 Lash Adjuster Thrust Washer
19 Lash Adjuster Retainer
20 Side Cover Gasket
21 Housing Side Cover
22 End Yoke Nut
23 End Yoke Key
24 Steering Shaft Oil Seal
25 Housing Upper Cover
26 Bearing Adjusting Shims
27 Ball Nut Stops
28 Worm Bearing Cup - Lower
29 Worm Bearing - Lower
30 Worm Bearing Cone - Lower
31 Steering Shaft Worm
32 Worm Bearing Cone - Upper
33 Worm Bearing Cup - Upper
34 Worm Bearing - Upper
35 Steering Shaft End Yoke

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Figure 11—Mechanical Steering Gear Assembly

Pitman arm; then install stud nut and new cotter pin. Tighten nut firmly.

6. Connect propeller shaft universal joint yoke to yoke on steering gear worm, using two U-bolts and lock nuts.

7. Lubricate all points in steering system as instructed in LUBRICATION (SEC. 13).

STEERING GEAR OVERHAUL

(Key Numbers in Text Refer to Figure 11)

DISASSEMBLY

The steering gear parts must be kept free from dirt or other foreign matter during overhaul procedures.

1. Remove plugs and drain as much lubricant as possible from the housing.

2. Mount steering gear assembly in a vise or holding fixture with the worm shaft horizontal. Do not grip the housing too tightly in vise.

3. Loosen lock nut (10); then remove back-up adjuster (9), packing, and lock nut. Discard packing.

4. Remove vent assembly from housing. Remove cotter pin and nut (22) attaching propeller shaft yoke (35) to steering gear worm (31); pull yoke off worm.

5. Remove lock nut (2) from lash adjuster screw (1). Remove four bolts and lock washers attaching side cover (21) to housing. Remove side cover and bearing assembly (4), using a screwdriver to thread lash adjuster screw out of cover as cover is withdrawn. Remove and discard side cover gasket (20).

6. Make sure the worm shaft (31) is horizontal and rotate shaft as necessary to position sector gear (17) on Pitman shaft (12) so it will pass through opening in gear housing; then withdraw Pitman shaft (12) from gear housing.

NOTE: Horizontal position of the worm shaft is necessary to prevent ball nut (5) from running down to end of worm as Pitman shaft (12) is withdrawn, thereby damaging the ball return guides.

7. Remove four bolts and lock washers attaching top cover (25) to housing (11); then carefully withdraw top cover, worm, and ball nut assembly as a unit. Remove lower worm thrust bearing (29).

8. Remove top cover (25) from worm shaft (31). Remove upper thrust bearing (34) from top cover (25). Retain shim pack (26) for reassembly of steering gear.

IMPORTANT: Do not hold worm shaft (31) in a vertical position as ball nut (5) will travel by its own weight to end of shaft. If ball nut sharply strikes either end of shaft worm, ball guides (8) will be damaged.

9. Try action of ball nut (5) on shaft worm (31). Ball nut must rotate smoothly with no evidence of binding or roughness. Tape shaft worm at both ends of ball nut to keep nut from running up or

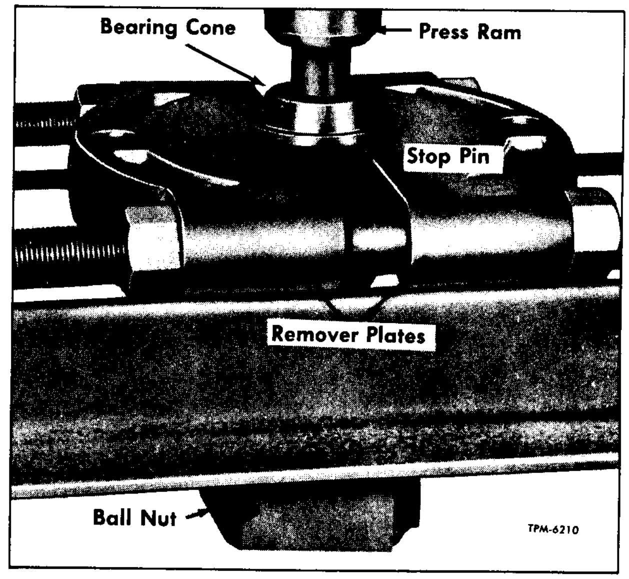


Figure 12—Removing Lower Worm Thrust Bearing Cone

down; then lay the assembly flat on work bench until ready to disassemble.

10. Remove lower thrust bearing cone (30) from worm shaft (31), using bearing remover plates (J-8176) (fig. 12).

11. Remove lower ball nut pin stop (27).

12. Remove screws attaching ball guide clamp to ball nut (5). Remove clamp. Pull ball guides out of ball nut as shown in figure 13. Remove balls (6) from guides by separating guides.

13. Remove tape from shaft worm; then turn ball nut upside down over a clean pan and rotate worm shaft back and forth until all balls have been removed. Pull ball nut endwise from worm shaft.

14. Remove upper thrust bearing cone (32) from worm shaft (31), using bearing remover plates (J-8176). Refer to figure 12. Remove upper ball nut stop pin (27) from worm shaft.

15. Remove Pitman shaft oil seal (15) from gear housing (11) and discard.

16. Remove worm shaft oil seal (24) from top

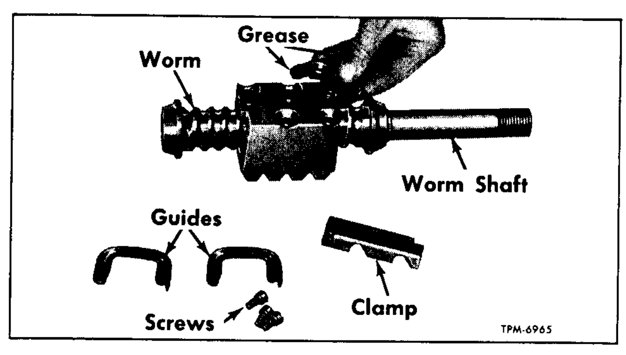


Figure 13—Ball Guide Removal and Installation (Typical)

MECHANICAL STEERING

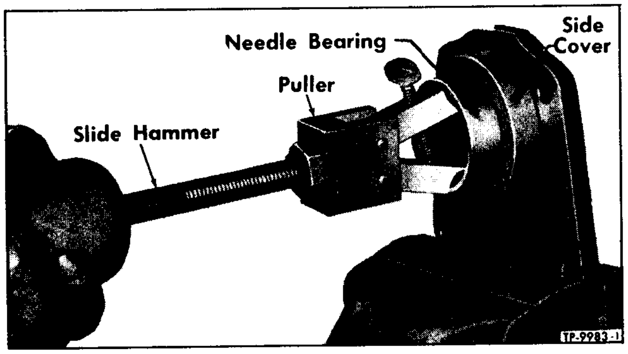


Figure 14—Removing Side Cover Needle Bearing (Typical)

cover (25) and discard. New oil seals should be used when reassembling the steering gear.

17. Removal of lower worm thrust bearing cup (28) from housing, upper thrust bearing cup (33) from top cover, needle bearing (4) from side cover, and needle bearings (16) from housing should be deferred until inspection of parts indicate necessity for further disassembly.

CLEANING AND INSPECTION

1. Wash all parts thoroughly in suitable cleaning solvent and wipe or blow parts dry prior to inspection, repair, and reassembly of the steering gear. Procedure should not be attempted in dirty surroundings. Parts must be absolutely clean.

2. Inspect steering gear housing and side cover for cracks, distortion, and condition of threads in tapped holes. Replace parts if damaged.

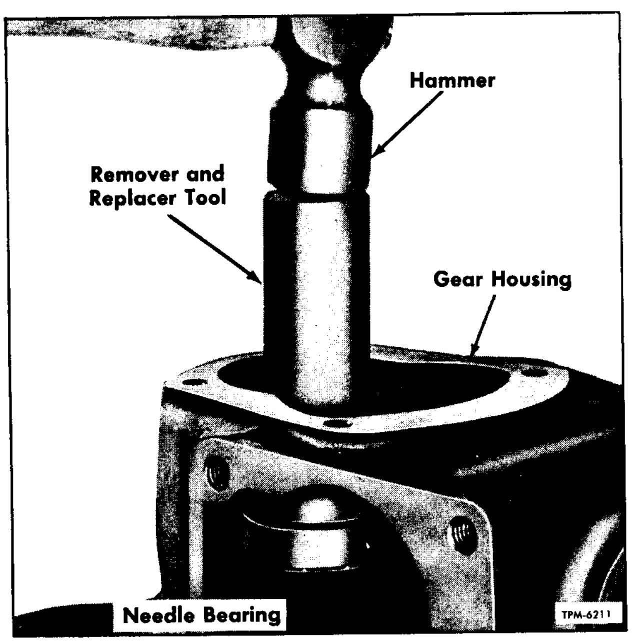


Figure 15—Removing or Installing Needle Bearing in Housing (Typical)

3. Examine needle roller bearings in housing and side cover for cracked, chipped, or worn rollers. If worn or damaged, bearing assemblies must be replaced as directed later under "Pitman Shaft Bearing Replacement."

4. Inspect Pitman shaft sector teeth and mating worm nut teeth for wear or damage. Check Pitman shaft for wear at bearing surfaces. If excessive wear is evident, replace shaft. Check condition of threads on lash adjuster screw, and check amount of screw end play in shaft. Any damage will necessitate replacement of lash adjuster screw; however, if screw is only loose (more than 0.005" end play), an adjustment may be made. Replacement and adjustment instructions are given later under "Lash Adjuster Replacement and Adjustment."

5. Inspect worm tapered roller bearing assemblies for worn or damaged rollers; also inspect bearing cups in top cover and housing and upper and lower bearing cones for wear or damage. If either the bearing rollers, cups, or cones are damaged, replace with complete new bearing assemblies. Instructions for replacing bearing cups are given later under "Worm Thrust Bearing Cup Replacement."

6. Inspect steering worm shaft for scoring, distortion, or wear.

7. Examine ball nut for scuffing, scoring, or wear on rack teeth and on ball thread groove. Check all holes and passages for obstructions. Check worm balls for flat spots, checking, wear, or damage. Balls should all be the same size within 0.0001".

8. Check expansion plug in housing for looseness or signs of grease leakage. If apparent, replace plug as follows:

a. Remove plug from housing by pressing center of plug outward from housing. As curvature of plug is changed, it will become loose and can easily be removed without damage to housing.

b. While expansion plug is removed, check condition of lower worm thrust bearing cup. Replace if necessary, as described later under "Worm Thrust Bearing Cup Replacement."

c. Position new expansion plug in gear housing with convex side facing out. Press on center of plug to deform it inward to secure in housing.

9. Inspect ball return guides for distortion or damage. Place two halves of a guide together and try action of balls in guide. Replace guides if any restriction exists. Check return guide clamp.

10. Check end cover for cracks or damage.

STEERING GEAR REPAIR

PITMAN SHAFT BEARING REPLACEMENT (Fig. 11)

When inspection indicates the need of replacing Pitman shaft needle roller bearings (4 and 16)

in housing and side cover, it is recommended that suitable tools be used to remove and replace bearings to avoid damage to the bearings and steering gear housing.

1. Pull needle bearing from side cover, using puller tool (J-3187-A) with slide hammer (J-2619) (fig. 14).

2. Press or drive needle bearings from steering gear housing, using remover and replacer tool (J-5529) (fig. 15).

3. Install bearings in both side cover and gear housing with remover and replacer tool (J-5529). During installation, press only against the stamped identification side of bearing. Press side cover bearing in flush with face of side cover.

WORM THRUST BEARING CUP REPLACEMENT

1. Using a suitable punch and hammer, drive bearing cup (28) from steering gear housing.

2. Position new bearing cup squarely over recess in gear housing and press cup in until it is firmly and evenly seated. Use old cup to press new cup into place.

3. Repeat these procedures for top cover bearing cup (33) replacement.

LASH ADJUSTER REPLACEMENT AND ADJUSTMENT

1. Lash adjuster retainer is tack-welded in end of Pitman shaft (fig. 16). Break tack-weld and withdraw retainer from shaft. Remove adjuster screw and thrust washer.

2. Install a new thrust washer and adjuster screw, lubricating end of adjuster screw with recommended steering gear lubricant.

3. Screw retainer in tight; then back off 30 degrees to obtain correct adjustment. Tack-weld retainer at points shown in figure 16.

ASSEMBLY OF STEERING GEAR

GENERAL

One of the most important phases when assembling the steering gear is cleanliness. All parts must be kept clean. Any bits of abrasive material which may get inside the housing during assembly procedures will quickly damage the gear mechanism. Grease and oil used at assembly must be free from dirt. When handling parts, make certain that hands are clean and that clean cloths are used. Pre-lubricate all bearings, oil seals, and moving parts at assembly with proper lubricant specified in LUBRICATION (SEC. 13) of this manual.

ASSEMBLING BALL NUT AND WORM

1. Install worm ball nut over shaft worm with return guide holes in ball nut up. Align grooves in worm and ball nut by sighting through bottom of ball return guide holes.

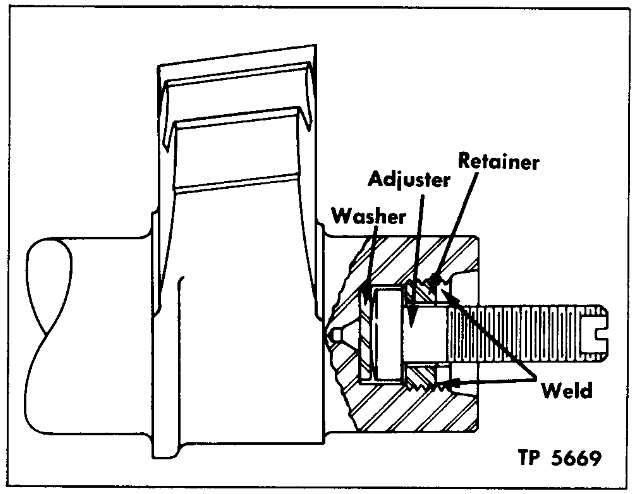


Figure 16—Installation of Lash Adjuster Screw

2. Divide total number of balls into two clean containers (42 balls for each circuit).

3. Drop balls into one of the return guide holes in upper circuit of nut. Gradually turn shaft away from that hole while inserting balls. Continue until the circuit is filled from bottom of one hole to bottom of the other, or until stopped by reaching end of the shaft worm (fig. 17).

4. In event balls are stopped by reaching end of shaft worm, hold down balls already installed with a rod or punch in return guide hole (fig. 17). Turn shaft in the reverse direction a few turns. Filling of the circuit can then be continued. It may be necessary to work shaft back and forth, holding balls down, first in one hole and then in the other. This will close up spaces between balls, filling the circuit completely and solidly.

5. Lay one-half of a ball guide on bench with groove up. Place the remaining balls for the first circuit into groove of the guide (fig. 18). Close this half of ball guide with other half. Hold the two halves together and plug each open end with heavy

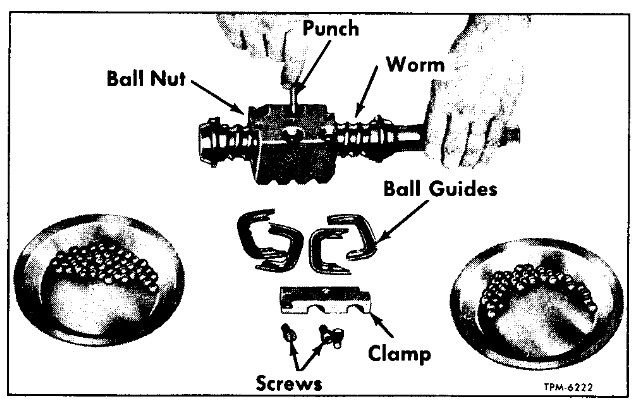


Figure 17—Filling Ball Circuits in Nut (Typical)

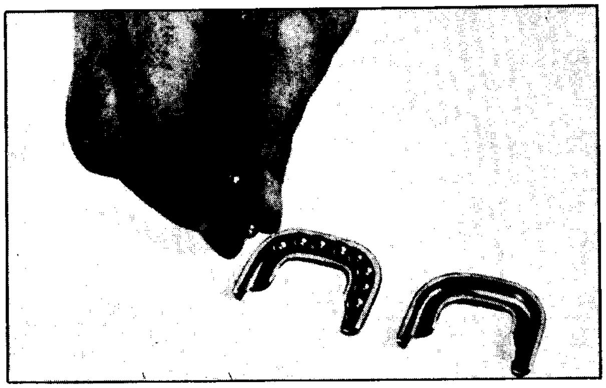


Figure 18—Filling Ball Guides

grease to prevent balls from dropping out.

6. Push ball return guides, with balls, completely into return holes in ball nut. Tap guide lightly with screwdriver handle to seat if necessary. This completes one circuit of balls.

7. Fill lower ball circuit in ball nut in same manner as described for upper ball circuit.

8. Install ball return guide clamp on ball nut, using the three screw and lock washer assemblies. Tighten screws securely.

9. Thoroughly lubricate ball nut and balls; then test assembly by rotating ball nut on shaft worm. Do not rotate ball nut to end of worm threads as this may damage ball guides. If motion of worm nut is not free, cause of bind must be located and trouble corrected. Bent ball guides may restrict ball circuit travel.

10. Temporarily tape shaft worm at both ends of ball nut to keep nut from running up or down; then until ready to install in gear housing, lay the assembly flat on work bench.

INSTALLATION OF WORM, BALL NUT, AND TOP COVER ASSEMBLY

1. Lubricate new worm oil seal (24) and press in base of top cover. Seal should be positioned so that lip of seal faces toward steering gear housing.

2. Install ball nut upper stop pin (27) in worm shaft slot.

3. Press upper thrust bearing cone (32) on worm shaft, using bearing installer plates (J-8176).

4. Install ball nut lower stop pin (27) in slot in worm shaft.

5. Press lower thrust bearing cone (30) on worm shaft, using bearing installer plates (J-8176).

6. Mount steering gear housing in holding fixture or vise so that top cover opening is up. Do not grip too tightly.

7. Lubricate worm thrust roller bearing (29) and position in cup (28) in lower end of gear housing.

8. Place original pack of shims (26) on top cover (25). Shims are available in 0.002", 0.005", 0.010", and 0.030" thickness. A minimum of three 0.002" and two 0.005" shims must be used for initial adjustment.

9. Lubricate upper worm thrust bearing (34); then position bearing on upper end of worm shaft over upper cone (32). Place top cover (25) over shaft and on bearing.

10. Remove tape from shaft worm at both ends of the ball nut; then gently rotate ball nut assembly so that it contacts stop pin (27) in lower end of the worm.

11. Lift top cover, worm, and ball nut assembly by grasping top cover and worm. Turn the shaft into a vertical position so that ball nut is on the bottom. Carefully guide the assembly into gear housing until bearing cone (30) on worm shaft contacts lower worm thrust bearing (29). In so doing, rotate the worm so ball nut return guide clamp faces the back-up adjuster opening in the housing. Bolt top cover to gear housing. Tighten bolts to 35-45 foot-pounds torque.

12. Accomplish all procedures described in steps 1 through 10 under "Installation of Pitman Shaft and Side Cover" following:

INSTALLATION OF PITMAN SHAFT AND SIDE COVER

1. With gear housing positioned in vise or holding fixture so that worm shaft (31) is horizontal, proceed as follows:

2. While holding worm nut (5), turn worm shaft to move nut to center of worm. This is necessary so that worm nut and Pitman shaft will mesh properly when the shaft is installed. Center tooth on Pitman shaft sector (17) must enter center space in worm nut (5).

3. Apply proper lubricant to shaft bearings (16) in gear housing. Position Pitman shaft in gear housing, being careful not to damage bearings with serrated end of the shaft.

4. Position a new gasket (20) on gear housing side cover opening.

5. Apply proper lubricant to side cover bearing (4). Place side cover on lash adjuster screw (1) in Pitman shaft. With screwdriver through hole in side cover, thread lash adjuster screw through cover until cover is pulled against housing. Back off lash adjuster screw a few additional turns to provide backlash between sector gear (17) on shaft and ball nut (5).

6. Install side cover to housing attaching bolts (3) and lock washers. Tighten bolts to 25-35 foot-pounds torque. Install adjuster screw lock nut (2) loosely.

7. Install new Pitman shaft oil seal (15) carefully over Pitman shaft so that serrations on shaft do not damage seal. Lips of oil seal should face inside of gear housing. Be sure oil seal is well seated in housing. Tool used to install bearing in housing may be used to install oil seals.

8. Install back-up adjuster, new packing, and lock nut loosely in the gear housing. Do not make adjustment until all other adjustments have been made.

9. Tap Woodruff key (23) into key slot in worm shaft and install propeller shaft yoke (35). Secure yoke on worm shaft with nut and cotter pin.

10. Install bushing and lubrication fitting in tapped boss in bottom of gear housing. Fill gear housing with proper lubricant as described in LUBRICATION (SEC. 13) of this manual.

11. Install the steering gear assembly in coach as described earlier in this section under "Steering Gear Replacement."

12. Adjust worm bearings, and make Pitman shaft lash adjustment as previously directed in this section under "Steering Gear Adjustments."

13. Tighten back-up adjuster (9) until adjuster bottoms against ball nut return guide clamp. Back off adjuster 1/4 turn and secure in place with adjuster lock nut. Tighten lock nut to 30-50 foot-pounds torque. Purpose of the back-up adjuster is to keep the worm shaft from flexing up and down.

STEERING DRAG LINK

DESCRIPTION

Steering drag link assembly is a three piece type, comprised of drag link tube and two socket end assemblies. As shown in figure 19, drag link ends are roller bearing type and incorporate an adjustment feature which automatically compensates for wear on bearing surfaces. Both end assemblies are identical, except that end assembly at Pitman arm screws onto drag link to provide for length adjustment, while end at steering arm is integral with drag link tube. Drag link end at Pitman arm is retained on drag link with clamp bolts.

MAINTENANCE

Linkage between steering gear and front axle definitely affects steering action if parts are out of adjustment, bent, or twisted. Check steering geometry and front wheel alignment as directed in FRONT AXLE (SEC. 1) when steering linkage is repaired or replaced.

Drag link end stud nuts must be kept tight or stud holes in steering arm and Pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs into arms so far that dust cover parts may be damaged during sharp turns.

Drag link ends are equipped with lubrication fittings and should be lubricated as directed in LUBRICATION (SEC. 13).

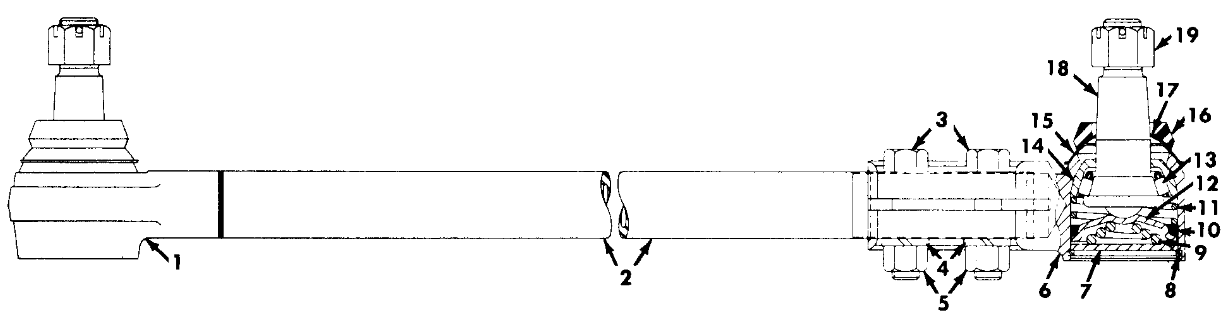
LENGTH ADJUSTMENT

It should not be necessary to alter length of drag link except when new link is installed or when removable end has been removed for overhaul. If necessary to adjust drag link length, proceed as follows:

1. Position front wheels in straight-ahead position.

2. Remove drag link ends from Pitman arm and steering arm.

3. Locate center of steering movement by turning steering wheel from extreme right to ex-



1 End Socket	8 Plug Lock	14 Bearing Race
2 Drag Link Tube	9 Seat Spring	15 Inner Dust Cover Washer
3 Socket Clamp Bolt	10 Grease Retainer	16 Dust Seal
4 Lock Washers	11 Socket Centering Spring	17 Outer Dust Cover Washer
5 Nuts	12 Stud Seat	18 End Stud
6 End Socket	13 Stud Bearing	19 Stud Nut
7 Plug		

TPM-6945

Figure 19—Drag Link Assembly

MECHANICAL STEERING

treme left, counting the number of turns, then back up exactly half way.

4. Check position of Pitman arm. Refer to "FRONT END ALIGNMENT" (SEC.1) of this manual.

5. Connect fixed drag link end to steering arm.

6. Stud at adjustable end of drag link should fit in Pitman arm without changing position of Pitman arm or front wheels.

7. If parts do not assemble correctly, first check all linkage for bends or distortion. If none of the drag link parts are found to be bent or twisted, loosen clamp bolts; then turn drag link end enough to obtain length to permit installation of end stud in Pitman arm without twist or bind.

8. Tighten clamp bolts firmly; then test adjustment. Front wheels should turn from right to left extremes without noticeable binding at drag link ends.

REMOVAL AND DISASSEMBLY

Key numbers in text refer to figure 19.

Normal wear on bearing surfaces in drag link end socket will result in increased overall height of the assembly. If excessive play is noted, drag link ends must be disassembled for replacement of worn parts.

1. Disconnect drag link ends from steering arm and Pitman arm by removing cotter pins and nuts from end studs and driving studs out of arms.

2. Loosen clamp bolt nuts and unscrew drag link end from drag link at Pitman arm end.

3. Remove dust seal (16), outer dust cover washer (17), and inner dust cover washer (15) from stud end (18).

4. Pry end plug lock (8) out of drag link end socket (6); then remove end plug (7), end stud seat spring (9), end stud seat (12), grease retainer (10), socket centering spring (11), end stud (18), end stud bearing (13), and end stud bearing race (14) from drag link end socket.

CLEANING AND INSPECTION (Fig. 19)

1. Immerse all parts except dust seal in a suitable cleaning solvent. Use a stiff bristle brush, as required, and clean parts thoroughly.

2. Check all parts for wear or corrosion and discard parts that are badly damaged.

3. Check tension of end stud seat spring (9) and centering socket spring (11). Discard springs if tension is not within limits. Refer to "Specifications" at end of this section.

4. Carefully inspect rollers in end stud bearing assembly (13) for roughness or flaking. If rollers will not rotate freely in bearing race (14), bearing assembly should be replaced.

ASSEMBLY AND INSTALLATION (Fig. 19)

Keep all parts clean when performing assembly operations. If dirt or grit is allowed to get into drag link end socket when assembling, premature and excessive parts wear will result.

1. Lubricate all parts with lubricant specified in LUBRICATION (SEC. 13); then place end stud bearing (13) and end stud bearing race (14) on end stud (18).

2. Insert end stud and bearing assembly into drag link end socket (6); then press grease retainer (10) over spring seat (12). Place centering socket spring (11) and spring seat in drag link end; then install end stud seat spring (9) and end plug (7). Secure parts in drag link end socket (6) with end plug lock (8).

3. Install on threaded end of stud, in following order, inner dust cover washer (15), outer dust cover washer (17), and dust seal (16).

4. Install drag link end assembly on drag link, but do not tighten clamp bolt nuts.

5. Place drag link in position on coach and attach to steering arm and Pitman arm with lock nuts. Tighten nuts to 150 foot-pounds torque and advance to nearest cotter pin slot. Install new cotter pins.

6. Adjust length as previously directed under "Length Adjustment" in this section; then lubricate as directed in LUBRICATION (SEC. 13) of this manual.

MECHANICAL STEERING SYSTEM SPECIFICATIONS

STEERING COLUMN

Steering Wheel Diameter	22″
Steering Bevel Gear Assembly	
Ratio	1.5 to 1
Total Ratio Bevel Gear and Steering Gear	38.4 to 1
Upper Bevel Pinion	
Number of Teeth	18
Lower Bevel Gear	
Number of Teeth	27
Backlash Between Gears	
Without Any Bind in Gears	Max. 0.002″
Backlash Adjustment Method Upper Bevel Pinion	Shims
Shim Thickness	0.003″ and 0.010″
End Play	None
Lower Bevel Gear	Adjuster Screw
End Play	None

BEARINGS

Steering Column Upper Shaft	
Outside Diameter Outer Race	2.144″-2.146″
Inside Diameter Inner Race	1.1305″-1.1320″
Steering Shaft Lower	
Type	Roller
Inside Diameter	1.002″-1.007″
Outside Diameter	1.542″-1.552″
Width	0.0779″-0.0781″
Number of Rollers	30
Bearing Race	
Inside Diameter	1.002″-1.012″
Outside Diameter	1.532″-1.552″
Thickness	0.123″-0.126″

MECHANICAL STEERING SYSTEM SPECIFICATIONS (CONT.)

BEARINGS (Cont.)
- Bevel Gear
  - Type . . . Roller
  - Inside Diameter . . . 0.377"-0.382"
  - Outside Diameter . . . 0.792"-0.802"
  - Width . . . 0.0781"-0.0779"
  - Number Rollers . . . 12
  - Bearing Race
    - Inside Diameter . . . 0.377"-0.387"
    - Outside Diameter . . . 0.782"-0.802"
    - Width . . . 0.030"-0.332"
- Bevel Gear Housing
  - Type . . . Needle Bearing
  - Inside Diameter . . . 0.9995"-1.0000"
  - Outside Diameter . . . 1.2495"-1.2505"
  - Width . . . 0.740"-0.750"
- Housing Cap
  - Type . . . Needle Bearing
  - Inside Diameter . . . 1.4995"-1.5000"
  - Outside Diameter . . . 1.8745"-1.8755"
  - Width . . . 0.990"-1.000"
- Steering Column Universal Joint
  - Type . . . Roller
  - Number Rollers . . . 20

SPRINGS
- Horn Cap
  - Free Length . . . 1.359"
  - Compressed Length Under 4 lbs. . . . 0.234"
- Shaft Upper Bearing
  - Free Length . . . 1.0937"
  - Compressed Length Under 40-50 lbs. . . . 0.8125"

STEERING GEAR

- Make . . . Saginaw
- Type . . . Recirculating Ball and Sector Nut
- Gear Ratio . . . 25.6 to 1
- Model . . . 572-D-1
- Worm Nut
  - Type . . . Ball
  - Ball Diameter . . . 0.3749"-0.3751"
  - Number of Balls . . . 84
- Adjustments
  - Worm Bearings
    - Adjustment Type . . . Shims
    - Shim Sizes Available . . . 0.002", 0.005", 0.010", and 0.030"
      NOTE: Use a minimum of (3) 0.002" and (2) 0.005" thick shims.
    - End Play in Worm . . . None
    - Pull to Keep the Worm Moving . . . 1½ to 2 lbs.
  - Pitman Shaft Lash
    - Adjustment Type . . . Adjuster Screw
    - Pull Through Center (Includes Worm Bearing Load) 2¾ to 3¼ lbs.
  - Back-Up Adjuster . . . Screw in until stop bottoms; then back off ¼ turn and tighten lock nut to 30-50 foot-pounds torque.
- BEARINGS
  - Worm Thrust . . . Tapered Roller
  - Pitman Shaft—Type . . . Needle
    - Housing
      - Inside Diameter . . . 1.8730"-1.8735"
      - Outside Diameter . . . 2.4369"-2.4375"
      - Width . . . 1.245"-1.250"
    - Side Cover
      - Inside Diameter . . . 1.7495"-1.7500"
      - Outside Diameter . . . 2.1245"-2.1255"
      - Width . . . 0.990"-1.000"

STEERING DRAG LINK

- Type . . . Adjustable Length
- Length—Centerline of Stud Centers . . . 33.22"
- Springs
  - Stud Seat Spring
    - Free Length . . . 0.750"
    - Compressed Length Under 350-400 lbs. . . . 0.500"
  - Socket Centering Spring
    - Free Length . . . 1.250"
    - Compressed Length Under 30 lbs. . . . 0.875"

STEERING PROPELLER SHAFTS

- Universal Joint (Slip Joint End) Front and Rear Shafts . . . 1281 Series
- Universal Joint (Fixed Joint End) Front and Rear Shafts . . . 1288 Series
- Journal Diameter . . . 0.5965"-0.5970"
- Bearing Rollers—Quantity . . . 23
  - Length—Front Shaft
    - End of Yoke at Slip Joint to Centerline of Journal at Fixed Joint End . . . $19\frac{7}{16}$"
  - Length—Rear Shaft
    - Center Line of Journal at Slip Joint End to Centerline of Journal at Fixed Joint End . . . $22\frac{5}{16}$"

PROPELLER SHAFT SUPPORT

BEARINGS
- Inside Diameter . . . 1.1811" + 0.0000" − 0.0004"
- Outside Diameter . . . 2.8346" + 0.0000" − 0.0005"
- Width . . . 1.1875" + 0.0000" − 0.005"
- Number of Balls . . . 12 per Row
- Size of Balls . . . $\frac{7}{16}$"

STUB SHAFT
- Length . . . 4"
- Diameter . . . 1.177"-1.179"
- Number of Splines . . . 10

TORQUE SPECIFICATIONS

Location	Ft.-Lbs.
Steering Column U-Bolt Nut	5-7
Steering Column Clamp Plate Support Bolt	15-20
Propeller Shaft U-Bolt Nut	15-20
Propeller Shaft Yoke to Bevel Gear Shaft Bolt	15-20
Bevel Gear Bracket to Side Member Bolt	25-30
Steering Gear Side Cover Bolt	25-35
Steering Gear Adjuster Screw Lock Nut	25-35
Steering Gear Back-Up Adjuster Lock Nut	30-50
Steering Gear Top Cover to Housing Bolt	35-45
Steering Column Clamp Plate to Support Bolt	30-35
Bevel Gear Housing to Bracket Bolt	35-45
Steering Gear to Support Stud Nut	45-55
Steering Wheel Retaining Nut	40-50
End Socket to Tie Rod Clamp Bolt	100-120
End Socket to Drag Link Clamp Bolt	100-120
Steering Gear Support Clip Nuts	90-110
Drag Link to Steering Arm Nut	150
Minimum and advance to nearest cotter pin slot.	
Drag Link to Pitman Arm Nut	150
Minimum and advance to nearest cotter pin slot.	
Steering Gear Housing to Axle Bolt	170-180
Pitman Arm to Steering Gear Shaft Nut	250-300

Power Steering

The power steering system, available as special equipment on coaches covered in this manual, provides automatic hydraulic assistance to the turning effort applied to the mechanical steering system.

The power steering system consists primarily of three units, used in conjunction with the conventional steering gear:

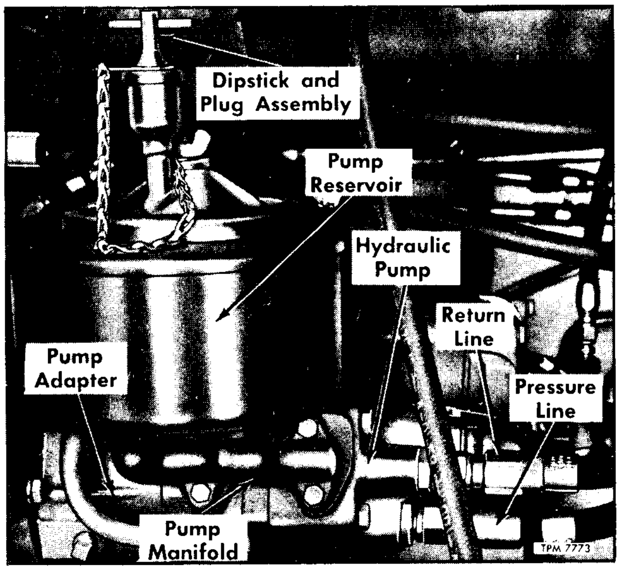


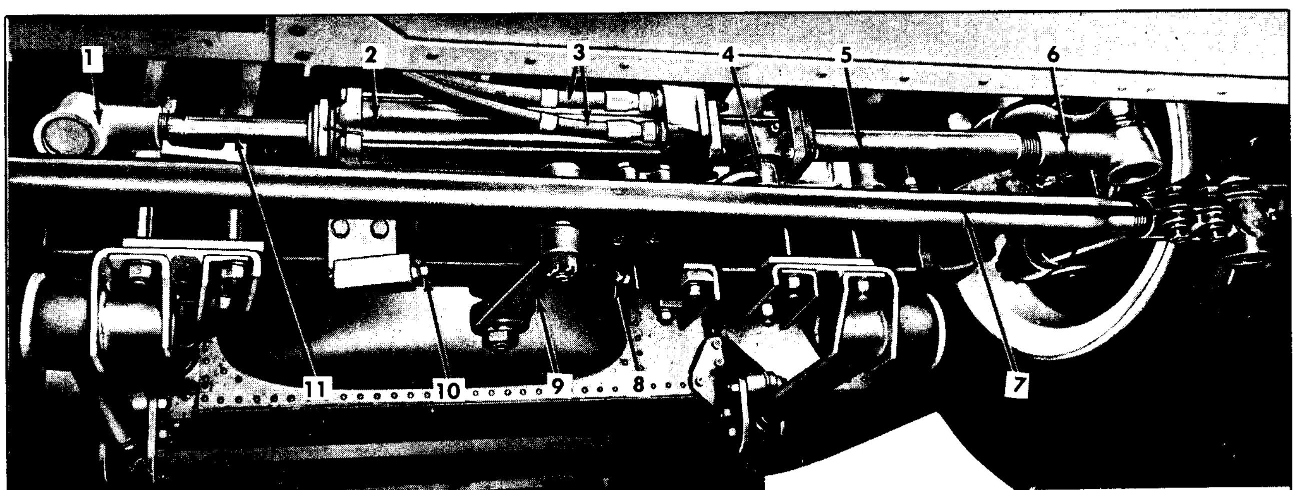
Figure 1—Power Steering Hydraulic Pump Installed

1. Control Valve.
2. Booster Cylinder.
3. Hydraulic Pump.

NOTE: The steering gear assembly, used with the power units on coaches equipped with power steering, is basically the same as the steering gear assembly described earlier in this section under "MECHANICAL STEERING" system. The procedures for adjustment, replacement, and overhaul are the same except when making worm bearing adjustment, pull required to keep the worm in motion should be 6-3/4 to 9 inch-pounds. When making Pitman shaft lash adjustment, pull through center (includes worm bearing load) should be 16 inch-pounds maximum.

OPERATION

Power steering is accomplished through use of hydraulic pressure. This pressure is supplied by a vane-type oil pump mounted at left rear of the engine. The pump is driven through a coupling by engine blower drive shaft (fig. 1). Pressure created by the pump is circulated through flexible fluid lines to a self-contained actuating booster cylinder installed on the front axle (fig. 2). Movement of steering wheel is transmitted through conventional Pitman arm and drag link to a control valve located in booster cylinder. This control valve directs hydraulic fluid, under pressure cre-



1 Piston Rod Socket End Assy.	4 Drag Link	8 Pitman Arm Right-Hand Stop
2 Booster Cylinder Assy.	5 Booster Extension Link	9 Pitman Arm
3 Pressure and Return Line Hoses	6 End Socket Assy.	10 Pitman Arm Left-Hand Stop
	7 Steering Tie Rod	11 Piston Rod TPM-7774

Figure 2—Power Steering Booster Cylinder Installed

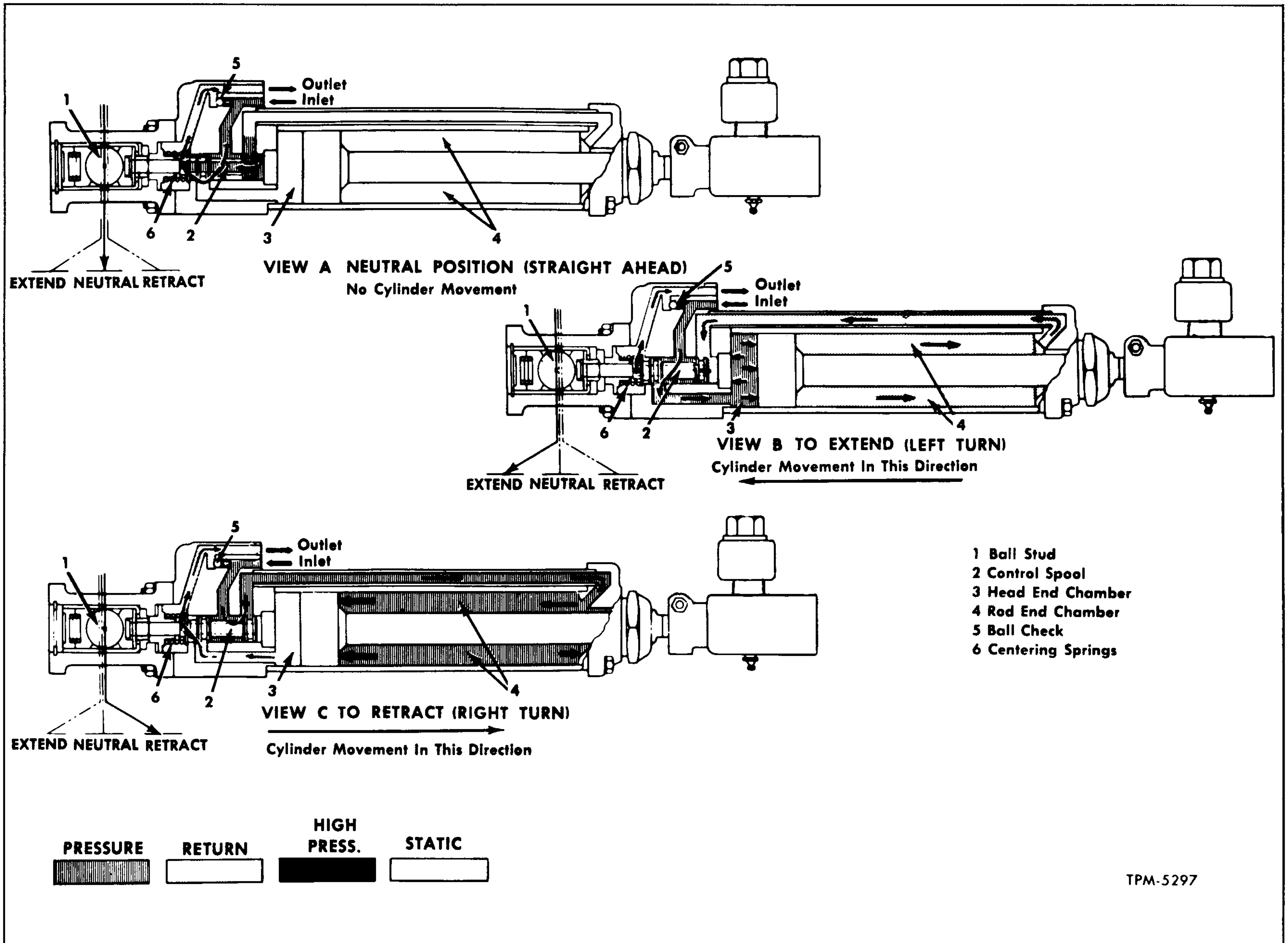


Figure 3—Operational Diagrams of Steering Booster Cylinder

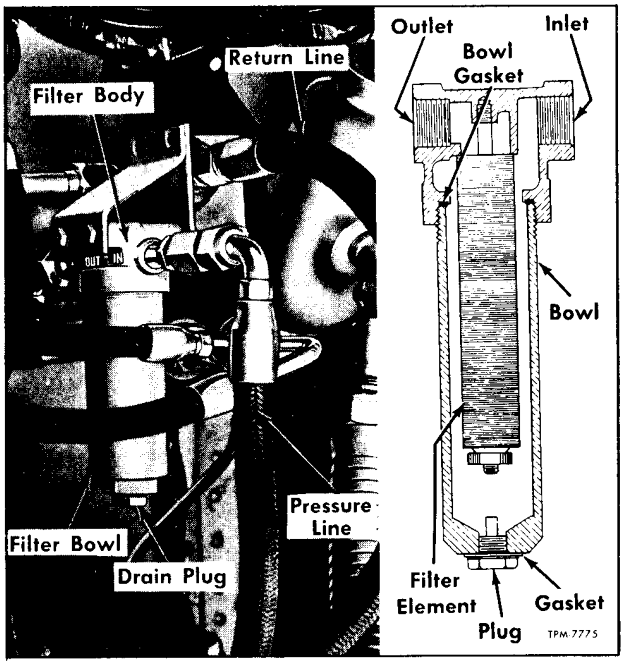


Figure 4—Fluid Filter Installed

ated by hydraulic pump, to either side of a piston in the booster cylinder, producing movement of piston and attached drag link of the coach steering linkage. Force applied by booster cylinder to drag link is automatically the amount of thrust necessary for all steering requirements.

Figure 3 illustrates schematic views of booster operations: View "A" illustrates neutral position; View "B" - left turn position (cylinder extended), and View "C" - right turn position (cylinder retracted).

Key numbers in the following text refer to figure 3.

Movement of steering wheel in either direction is transmitted to the mechanical linked ball stud (1) which in turn imparts linear movement to control valve spool (2). Oil flow from the hydraulic pump is directed by valve spool movement either to the head end or rod end chambers (3 or 4) of the booster cylinder as shown in Views "B" and "C," causing the booster to extend or retract. This action causes a corresponding movement of the booster which will continue so long as the control valve spool is offset by continued turning of the steering wheel. As soon as the turning of the steering wheel is stopped the booster will again come to center (neutral) position (View "A") and stop. In the event of power failure, check valve ball (5) will unseat, allowing free flow of oil throughout the booster. This will allow the steering mechanism to be moved manually, either by the steering wheel or by external force applied to the vehicle wheels.

Strong valve centering springs (6) on the control valve spool (2) provide the driver the desired steering "feel."

MAINTENANCE

The power steering hydraulic system requires little maintenance. However, the system should be kept clean to insure maximum operating performance and trouble-free service. Periodic inspection to check for leaks should also be made.

At regular intervals the hydraulic fluid level in pump reservoir should be checked and fluid added when required. Refer to LUBRICATION (SEC. 13) of this manual for type fluid to be used, method, and intervals for filling. The fluid reservoir is mounted on the hydraulic pump. When the slightest evidence of dirt, sludge, or water is discovered in the system, drain and refill with clean recommended hydraulic fluid. Refer to LUBRICATION (SEC. 13) for procedures. To drain system, disconnect fluid lines at booster cylinder.

Power steering fluid filter located in fluid line at engine bulkhead (fig. 4) should be serviced at regular lubrication intervals. Refer to "Power Steering Fluid Filter" later in this section for servicing fluid filter.

Air in the fluid system will cause spongy action and noisy operation. When any hose has been disconnected or when fluid has been lost for any reason, the system must be bled after adding fluid. Bleed system as directed later in this section under "Bleeding Power Steering Hydraulic System." Should the power steering system become inoperative because of loss of hydraulic fluid, pump pressure line should be re-routed from pump outlet directly back to pump reservoir.

IMPORTANT: Do not operate pump without fluid in the pump reservoir.

If steering linkage between steering gear and front wheels is out of adjustment, bent, twisted, or worn, steering action of coach will be seriously affected. At any time steering linkage parts are repaired, replaced, or adjusted, steering geometry and front wheel alignment must be checked. Refer to FRONT AXLE (SEC. 1) of this manual for front end alignment information.

At regular lubrication intervals, the steering linkage should be checked completely for worn or loose ball stud end sockets.

If coach steering tends to wander in one direction, after making certain that front end is properly aligned, cause may be that the control valve in booster cylinder may not be centering properly. Adjust control valve as explained later under "Control Valve Adjustment."

BLEEDING POWER STEERING HYDRAULIC SYSTEM

When power steering hydraulic pump, booster cylinder assembly, or fluid filter has been removed for overhaul or replacement, or any hydraulic system lines disconnected, the hydraulic system must be bled before vehicle is again operated. Bleed power steering hydraulic system as follows:

NOTE: When hydraulic fluid is added to power steering system, fluid should be poured through a 200 mesh wire screen secured inside funnel. Use only the hydraulic fluid recommended in LUBRICATION (SEC. 13) of this manual in the power steering hydraulic system.

1. Fill power steering pump reservoir tank to "FULL" mark on dipstick. Let hydraulic fluid remain undisturbed for about two or three minutes.
2. Raise front end of coach until front wheels are well off floor.
3. Eliminate air pockets in booster cylinder and hydraulic system by turning front wheels to right and left Pitman arm stops. Continue this procedure, while maintaining fluid level in pump reservoir tank to "FULL" mark on dipstick, until fluid in pump tank stops bubbling.
4. Start engine and run at idle for two or three minutes. Turn front wheels to right and left as before. DO NOT HIT WHEEL STOPS. Maintain fluid level in pump reservoir tank to "FULL" mark on dipstick. Check system lines and connections for leaks. Continue these procedures until fluid in pump reservoir tank is clear and free of bubbles.
5. Increase engine speed to approximately half throttle and run engine at this speed until all signs of air bubbles cease to exist in pump reservoir tank. Turn wheels to right and left as before. DO NOT HIT PITMAN ARM STOPS.
6. Lower coach to floor and turn wheels to right and left while rechecking for fluid leaks.
7. Recheck fluid level in pump reservoir tank and fill to "FULL" mark on dipstick.

HYDRAULIC PRESSURE TEST

1. Disconnect pressure hose from fitting at the hydraulic pump.

NOTE: Some hydraulic fluid will leak out when line is disconnected. Provision should be made to catch this drainage.

2. Connect 0 to 1000 psi pressure checking gauge (J-5631-1) (fig. 5) between the pump pressure port and pressure hose. Leave valve in pressure gauge open.
3. Bleed steering hydraulic system to remove all air from pressure line as directed previously under "Bleeding Hydraulic System."
4. Start engine and run at idle speed. Turn wheels through normal operating range several times until the hydraulic fluid temperature reaches 170°F. When fluid temperature reaches 170°F., close valve in pressure gauge line and observe reading on pressure gauge. Pressure reading should be 950 to 1050 psi.

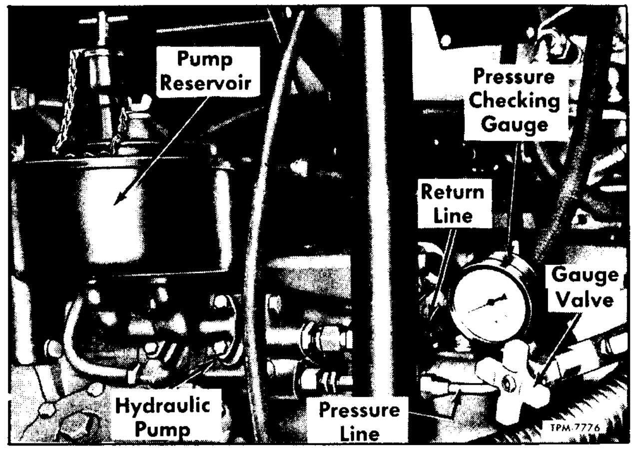


Figure 5—Checking Pump Hydraulic Pressure

IMPORTANT: Do not leave valve closed for more than 15 seconds.

5. Open valve in pressure gauge line. Turn wheels to extreme right and left against "stops" (with wheels on ground). At extreme right or left position the maximum pressure reading should be within the amount specified in procedure 4 above.
6. If pump pressure is less than amount specified, make necessary repairs described under "Hydraulic Pump Overhaul" later in this section.
7. If pump pressure is satisfactory, shut off the engine and remove pressure checking gauge.
8. Reconnect pressure hose to pump port fitting; then bleed hydraulic system as described previously under "Bleeding Power Steering Hydraulic System."

BOOSTER CYLINDER CONTROL VALVE ADJUSTMENT

Power steering booster cylinder is equipped with an adjustable control valve. At time of manufacture this valve is adjusted to provide straight ahead control, thus any tendency to wander to right or left can be corrected by proper adjustment of the control valve. Whenever the booster cylinder has been overhauled, or vehicle wanders to right or left, the following adjustment should be made.

In some instances operators may perform this adjustment on a bench, using an auxiliary source for hydraulic pressure. When adjustment must be made on the vehicle the following instructions apply:

1. Disconnect booster cylinder assembly from adjustable extension by removing four attaching nuts and bolts.

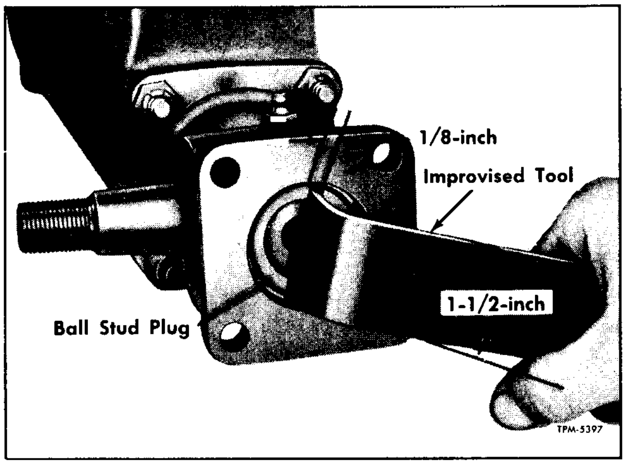


Figure 6—Removing Ball Stud End Plug with Improvised Tool

2. At piston rod end socket ball stud, remove cotter pin and nut. Remove ball stud from suspension support bracket.

3. At booster cylinder ball stud body, remove snap ring, lock key, end plug, and spring. NOTE: Use improvised tool shown in figure 6 to remove end plug. Remove ball stud and two ball stud seats. Remove centering nut locking washer from centering nut. Straighten tab on locking washer if washer is to be reused.

4. Suspend booster cylinder assembly in a horizontal position so that piston rod can extend or retract without interference.

5. Start engine and run at fast idle (approximately 600 to 700 rpm) to operate power steering

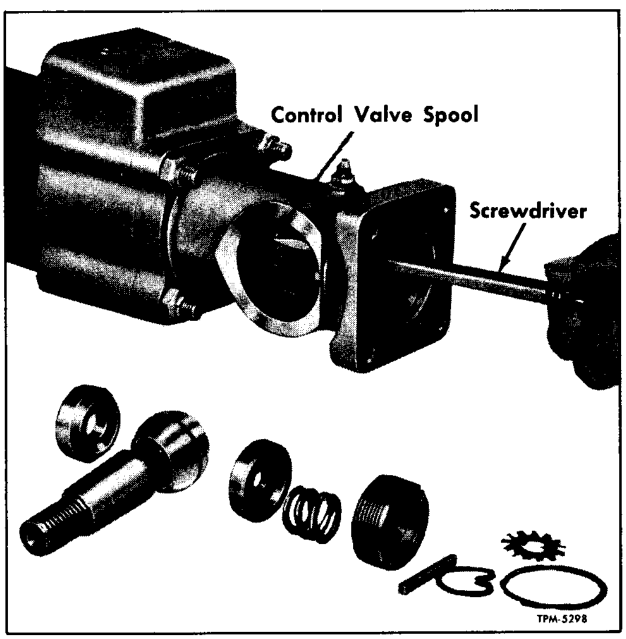


Figure 7—Adjusting Booster Cylinder Control Valve Spool

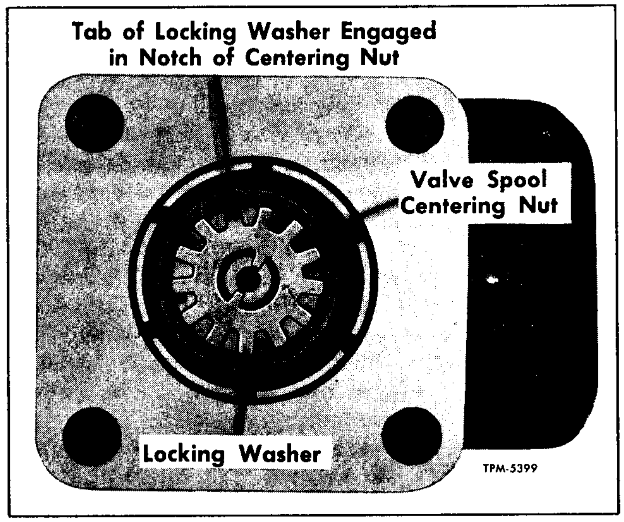


Figure 8—Valve Spool Locking Washer Installed

hydraulic pump. Insert a screwdriver in slot of spool as shown in figure 7. Hold the centering nut firmly in position, and adjust the spool until the rod is in 1/2 extended position. To do this turn the spool clockwise to retract or counterclockwise to extend the rod. The spool is centered when the rod does not creep in either direction.

6. Lock valve spool in place by installing centering nut locking washer. Insert inside diameter tabs of the locking washer in slot of spool. One of the outside diameter tabs should then line up with one of the centering nut slots. Bend tab of washer into slot of centering nut (fig. 8), using punch and hammer.

7. Install ball stud seat, ball stud, and second ball seat in body. Install ball stud seat spring; then thread end plug into body to secure ball stud and seats. Thread plug against the spring solidly; then back off to first key slot in ball stud sleeve. Install lock key and snap ring.

8. Recheck for piston rod creeping (Step 5 above); there must be no movement of rod. Repeat adjustment procedures if creeping of piston rod is apparent.

9. Position piston rod end socket ball stud in hole of suspension support bracket; then install stud nut, tightening securely. Install new cotter pin.

10. Align booster cylinder assembly with adjustable extension; then install four attaching bolts and lock nuts. Install new cotter pins.

11. Lubricate end socket ball stud as directed in LUBRICATION (SEC. 13) of this manual.

12. Bleed power steering system as described earlier in this section under "Bleeding Power Steering Hydraulic System."

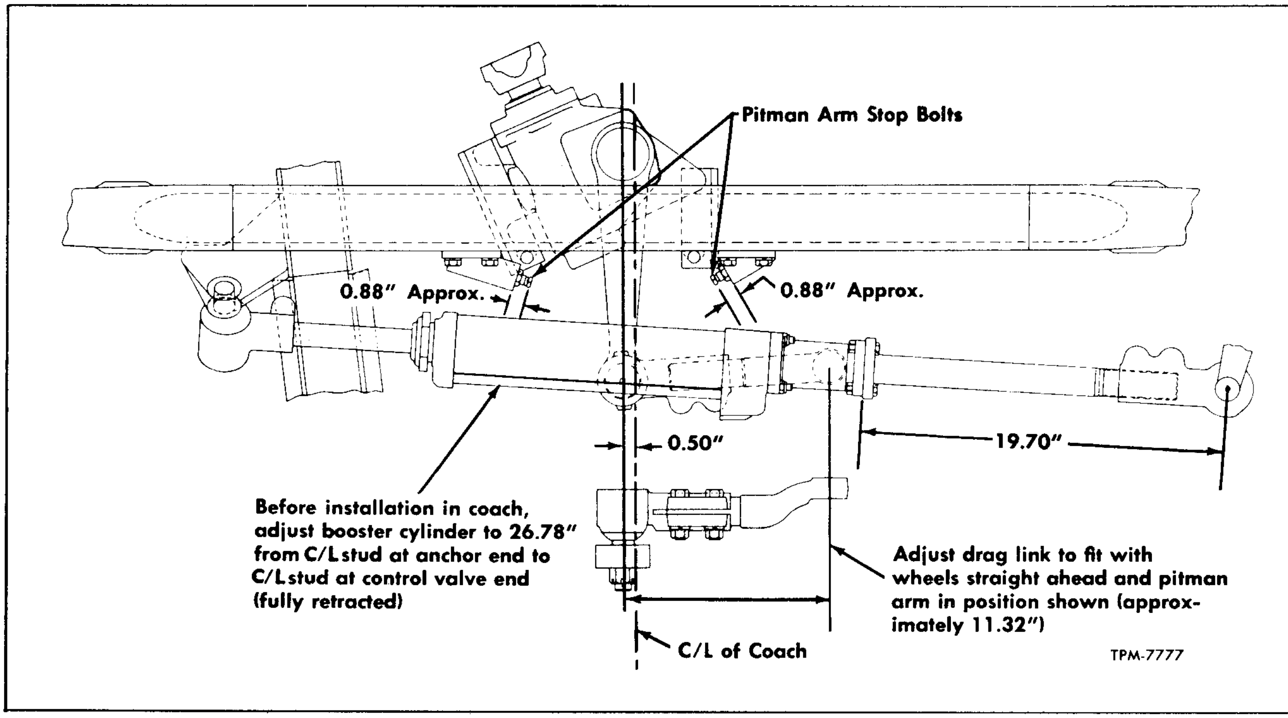


Figure 9—Power Steering Booster Cylinder Installation

BOOSTER CYLINDER REPLACEMENT

Power steering booster cylinder assembly, installed as shown in figure 2, can be readily removed from coach at any time service is required that necessitates disassembly or partial disassembly of the unit. Remove booster cylinder assembly from coach as described in the following text. When reinstalling booster cylinder assembly, be sure to accomplish adjustment procedures outlined.

REMOVAL

1. Attach identification tags to flexible pressure and return hoses; then remove hoses and drain fluid from hoses and cylinder into a clean pan.
2. Remove cotter pin and stud nut attaching adjustable steering drag link to booster cylinder ball stud. Discard cotter pin.
3. Remove cotter pin and stud nut attaching piston rod end socket tapered stud to suspension support bracket. Discard cotter pin.
4. Remove four cotter pins, nuts, and bolts attaching flange of booster cylinder ball stud body to flange of adjustable extension.
5. Remove booster cylinder assembly from drag link end and suspension support bracket. It may be necessary to use a suitable puller to aid in removal.
6. Remove dust cover spring and dust cover from booster cylinder ball stud.
7. Remove dust cover spring, shield, dust cover, and washer from piston rod end socket tapered stud to prevent loss of parts.
8. If necessary, remove set screw and clamp bolt; then turn piston rod end socket off piston rod.

INSTALLATION (Refer to Figs. 2 and 9)

1. Before installing booster cylinder assembly in coach, compress booster cylinder into fully retracted position; then thread piston rod end socket assembly on booster cylinder piston rod to a dimension of 26-25/32", measured from centerline of socket end tapered stud to centerline of booster cylinder ball stud.
2. Position dust cover and dust cover spring on booster cylinder ball stud.
3. Position washer, dust cover, shield, and dust cover spring on piston rod end socket tapered stud.
4. Check length of cylinder extension and end socket assembly, measuring from center of end socket ball stud to flange of extension (fig. 9). Distance should measure 19.70". Adjust if necessary to obtain these dimensions.
5. At this stage of installation the booster cylinder should be suspended horizontally under coach and fluid lines connected to unit; then the control valve should be adjusted for centering. See "Booster Cylinder Control Valve Adjustment" explained previously. Start with Step 3.
6. Position booster cylinder ball stud body

flange to flange of end socket extension, at the same time inserting booster cylinder ball stud in hole at end of drag link and piston rod end socket tapered stud into hole in suspension support bracket. NOTE: Cylinder ball stud to drag link must be positioned at bottom of cylinder.

7. Dip threads of extension bolts in Lubriplate #110; then attach booster cylinder ball stud body flange to flange of end socket extension with four bolts and lock nuts. Tighten bolts to 40-50 foot-pounds torque; then advance lock nuts to nearest cotter pin holes and install new cotter pins.

8. With booster cylinder ball stud inserted through hole at end of drag link, install stud nut on ball stud. Tighten stud nut to 150 foot-pounds torque; then advance nut to nearest cotter pin hole and install new cotter pin.

9. With piston rod end socket tapered stud inserted through hole in suspension support bracket, install stud nut on tapered stud. Tighten nut to 150 foot-pounds torque; then advance nut to nearest cotter pin hole and install new cotter pin to retain nut.

IMPORTANT: It is important that the following adjustments be checked.

10. Check position of Pitman arm on steering gear lever shaft as described previously under "Steering Gear Replacement." Front wheels must be positioned straight ahead. If steering gear Pitman arm is correctly positioned on shaft, centerline of hole at drag link end of Pitman arm will be 1/2" to the left of centerline of coach when viewed from the rear (fig. 9).

NOTE: Centerline of coach can be identified by prick punch marks on back of front axle beam.

If Pitman arm is incorrectly positioned on Pitman shaft, remove arm from shaft and reposition as previously directed.

11. Check adjustment and position of booster cylinder extension and socket end assembly. If socket end assembly and booster cylinder are installed and adjusted correctly, flange of extension and flange of booster cylinder ball stud body will be tipped heel down 3^{o} or almost level. (See figure 2.)

12. Check position and adjustment of steering drag link assembly as described under "Drag Link Adjustment" later in this section. If steering drag link assembly is correctly installed and adjusted, booster cylinder ball stud flange will be parallel with eye surface of drag link. End socket tapered stud will center in hole of Pitman arm and booster cylinder ball stud will center in hole at eye end of drag link. If steering drag link assembly is incorrectly installed and adjusted, remove steering drag link assembly from coach and reposition and adjust as described.

13. With all parts correctly positioned and adjusted, and all bolts and nuts properly torqued, connect inlet and outlet flexible lines to fittings of booster cylinder. Tighten set screw firmly in piston rod end socket at suspension bracket. Stake screw in three places.

14. Refill power steering hydraulic system and bleed system as directed previously under "Bleeding Power Steering Hydraulic System."

BOOSTER CYLINDER OVERHAUL

DISASSEMBLY

Key numbers in text refer to figure 10.

NOTE: If ball stud body (34), valve body (75), cylinder tube (44), and cylinder cap (48) have not been scribed with alignment marks, use prick punch and mark these parts so they can be reassembled in same relative position.

1. Remove socket clamp bolt nut (22) and bolt (9); then remove set screw (53) from piston rod end socket (52).

2. While holding piston rod (45) with 1" open end wrench, turn piston rod end socket (52) off piston rod (45).

NOTE: Overhaul piston rod end socket assembly as described later under "Booster Cylinder Extension and End Socket." These procedures will also apply to the piston rod end socket.

3. Remove four nuts (24); then remove four thru bolts (25) attaching cylinder tube and cap assembly to ball stud body assembly.

4. Using plastic hammer, tap valve body assembly off cylinder tube and cap assembly.

5. Remove oil passage tube (43) from bore in cylinder cap (48); then remove oil passage tube spring (47) from bore in cap.

6. Cut lock wire (8) from hole in piston rod packing nut (49); then turn packing nut off threads of cylinder cap.

7. Pull piston rod assembly out of cylinder tube and cap.

8. Remove one piston rod packing outer adapter (50), five piston rod chevron packing (55), and one piston rod packing inner adapter from cylinder cap. Discard packings.

9. Remove piston rod wiper seal (54) from piston rod packing nut (49). Discard wiper seal.

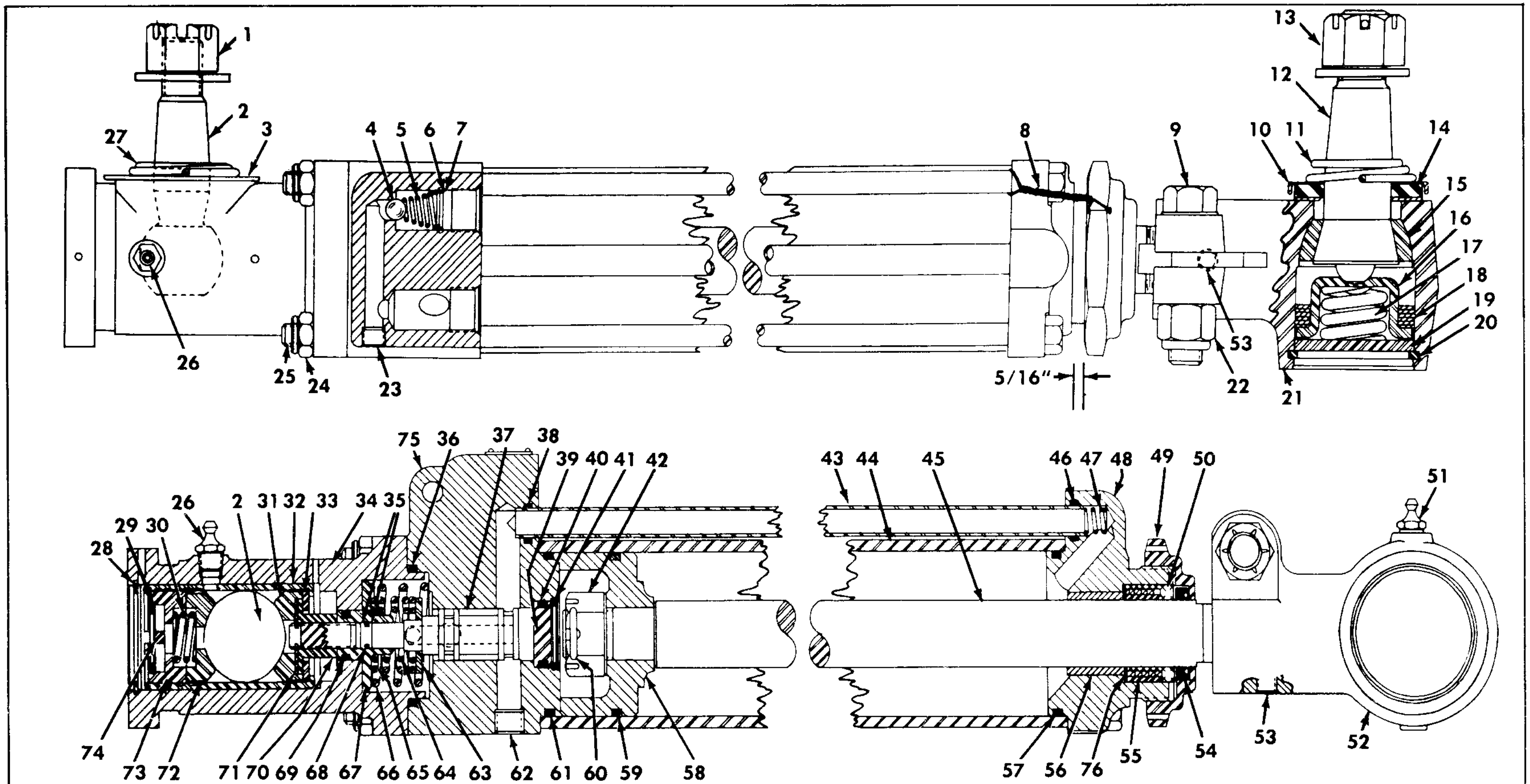
10. Separate cylinder tube (44) from cylinder cap (48). It may be necessary to tap on cap lightly with plastic hammer to separate units.

11. Remove cylinder cap O-ring seal (57) from cylinder cap (48). Discard seal.

12. Remove oil passage tube O-ring seal (46) from bore in cylinder cap (48). Discard seal.

13. Remove piston rod bushing (56) from bore in cylinder cap (48), only if inspection indicates necessity for removal.

14. Using fingers to spread ring, remove piston ring (59) from groove in piston (58). Do not



1 Stud Nut
2 Ball Stud
3 Dust Cover
4 Check Valve Ball
5 Check Valve Ball Spring
6 Ball Spring Washer
7 Snap Ring
8 Lock Wire
9 Clamp Bolt
10 Dust Cover Shield
11 Dust Cover Spring
12 Tapered Stud
13 Stud Nut
14 Dust Cover
15 Stud Bearing
16 Stud Spring Seat
17 Stud Spring
18 Grease Retainer
19 Stud Spring Retainer
20 Snap Ring
21 Socket End
22 Lock Nut
23 1/8" Pipe Plug
24 Thru Bolt Nut
25 Thru Bolt
26 Lubrication Fitting
27 Dust Cover Spring
28 Snap Ring
29 Snap Ring
30 Ball Stud Seat Spring
31 Ball Stud Inner Seat
32 Ball Stud Sleeve
33 Valve Centering Nut Washer
34 Ball Stud Body
35 Back-up Washers
36 O-ring Seal
37 Valve Spool
38 Oil Passage Tube O-ring Seal
39 Valve Body Plug
40 O-ring Seal
41 Snap Ring
42 Piston Rod Nut
43 Oil Passage Tube
44 Cylinder Tube
45 Piston Rod
46 O-ring Seal
47 Oil Passage Tube Spring
48 Cylinder Cap
49 Piston Rod Packing Nut
50 Packing Outer Adapter
51 Lubrication Fitting
52 Piston Rod End Socket Assembly
53 Set Screw
54 Piston Rod Oil Seal
55 Packing
56 Piston Rod Bushing
57 O-ring Seal
58 Piston
59 Piston Ring
60 Cotter Pin
61 O-ring Seal
62 1/4" Pipe Plug
63 Valve Centering Spring Washer
64 Valve Centering Spring (Inner)
65 Valve Centering Spring (Center)
66 Valve Centering Spring (Outer)
67 Centering Spring Retainer
68 O-ring Seal
69 O-ring Seal
70 Valve Centering Nut
71 Valve Centering Nut Locking Washer
72 Ball Stud Outer Seat
73 Ball Stud Sleeve Plug
74 Sleeve Plug Lock Key
75 Valve Body
76 Packing Inner Adapter

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Figure 10—Power Steering Booster Cylinder Assembly

spring ring more than necessary when removing from piston.

15. Pull piston rod nut cotter pin (60); then remove piston rod nut (42) and piston (58) from piston rod (45).

16. Remove oil passage tube O-ring seal (38) and valve body O-ring seal (61) from valve body (75). Discard both seals.

17. Using snap ring pliers, remove valve body plug snap ring (41) and valve body plug (39) from bore in valve body (75); then remove O-ring seal (40) from groove in plug. Discard seal. NOTE: It may be necessary to tap plug out of valve body with brass drift and hammer.

18. Using snap ring pliers, remove check valve ball spring snap ring (7); then remove washer (6), check valve ball spring (5), and check valve ball (4) from bore in valve body (75).

19. Remove valve body pipe plugs (23 and 62) from bores in valve body (75).

20. Remove valve outer centering spring (66) and valve body O-ring seal (36) from ball stud body (34). Discard seal.

21. Remove ball stud nut (1), dust cover spring (27), and ball stud dust cover (3) from ball stud (2). NOTE: If booster cylinder assembly was removed from coach just prior to disassembly procedures, these parts have been removed.

22. Using snap ring pliers, remove snap ring (28) and snap ring (29) from bore in ball stud body (34).

23. Remove lock key (74) from slots of ball stud plug (73) and ball stud sleeve (32).

24. Remove ball stud plug (73), ball stud spring (30), ball stud seat (72), ball stud (2), and ball stud seat (31) from ball stud body (34).

25. Remove locking washer (71) from end of spool stem, then turn centering nut (70) from stem by working screwdriver against lugs of nut. Remove flat washer (33) from spool stem.

26. Remove ball stud sleeve (32) from ball stud body (34).

27. Press valve spool (37) with attached springs, seals, and retainer as an assembly from ball stud body.

28. Remove valve centering spring retainer (67), valve middle centering spring (65), inner valve centering spring (64), and valve centering spring washer (63) from stem of valve spool (37).

29. Remove valve centering spring retainer O-ring seal (69) from groove of valve centering spring retainer (67). Discard seal.

30. Remove valve spool O-ring seal (68) and back-up washers (35) from groove in valve spool (37). Discard seal and back-up washers.

31. Remove ball stud lubrication fitting (26) from bore in ball stud body (34).

CLEANING AND INSPECTION

Key numbers in text refer to figure 10.

1. Wash all parts thoroughly in cleaning solvent, making sure all accumulations of dirt, grease, or other foreign material is removed. Wipe parts dry with clean lint-free cloth, or blow parts dry with compressed air.

2. Inspect all oil passages in valve body (75), valve spool (37), and cylinder cap (48) to make sure they are clean. A piece of tag wire should be used to check for obstructions.

3. Inspect piston rod bushing (56) in cylinder cap for scoring or excessive wear. If bushing is damaged, remove from cap. Discard bushing.

4. Check cylinder tube (44) and oil passage tube (43) for dents or damage. Make sure inside of tubes are clean.

5. Examine all finished surfaces for nicks, scores, or pitting. Small nicks may be removed with crocus cloth. Replace all parts found to be damaged.

6. Inspect oil seal and ring grooves in valve spool (37), spring retainer (67), valve body (75), valve body plug (39), cylinder cap (48), and piston (58) making sure they are clean and not damaged.

7. Check all booster cylinder springs for free length, compressed length, distortion, or collapsed coils.

8. Check piston ring (59) for excessive wear or damage.

9. Check thru bolts (25) for distortion and threads on bolts for stripped or crossed condition.

10. Inspect all threaded components of cylinder for stripped or crossed condition.

ASSEMBLY

Key numbers in text refer to figure 10.

The following assembly procedures are arranged in a practical sequence for assembling power steering booster cylinder. It is assumed that all parts have been cleaned and inspected, or replaced, as deemed necessary and previously described.

When assembling booster cylinder use new seals, packings, cotter pins, and lock wire. Lubricate each moving part with clean hydraulic fluid recommended in LUBRICATION (SEC. 13) of this manual, before part is installed. When installing new O-ring seals, make sure seals are properly seated in their respective grooves to prevent pressure loss and air intake into hydraulic system.

1. Install ball stud lubrication fitting (26) (if removed) in bore of ball stud body (34). Tighten fitting securely.

2. Install new valve spool O-ring seal (68) and back-up washers (35), with rough side against O-ring seal in groove in valve spool stem (37). Use a sleeve or cover with stiff paper to avoid cutting

O-ring seal in assembly. Make sure O-ring seal and back-up washers are properly seated in groove.

3. Install new valve centering spring retainer O-ring seal (69) in groove of spring retainer (67). Make sure seal is properly seated in groove.

4. Position valve centering spring washer (63), valve inner centering spring (64), valve middle centering spring (65), and valve centering spring retainer (67) over stem of valve spool (37).

5. Position valve spool assembly with springs in bore of ball stud body (34).

6. Insert ball stud sleeve (32) into ball stud body (34) and over spool stem.

7. Install flat washer (33) over spool stem, then thread spool centering nut (70) on spool stem (approx. 17 turns - leaving 3 full threads showing).

8. Position new valve body O-ring seal (36) and valve outer centering spring (66) over valve spool (37) and against ball stud body (34).

9. Install valve body pipe plugs (23 and 62) in bores of valve body (75). Tighten plugs securely.

10. Insert check valve ball (4), ball spring (5), and washer (6) in bore of valve body (75); then using snap ring pliers, install snap ring (7) to secure parts in place.

11. Install new O-ring seal (40) in groove of valve body plug (39), making sure seal is well seated in groove; then install plug with seal in bore of valve body (75).

12. Using snap ring pliers, install valve body plug snap ring (41) in groove of valve body (75).

13. Insert new valve body O-ring seal (61) and new oil passage tube O-ring seal (38) into grooves in valve body (75). Make sure both of these seals are well seated in their respective grooves.

14. Position piston (58) on piston rod (45); then install piston rod nut (42) on piston rod (45). Tighten nut firmly. Secure nut on piston rod with new cotter pin (60).

15. Using snap ring pliers to expand ring, install piston ring (59) in groove of piston (58). Do not expand ring more than enough to make the installation.

16. If piston rod bushing (56) was removed from cylinder cap (48) during inspection procedures, press new bushing into position in cylinder cap.

17. Position cylinder tube (44) in vise having soft jaw plates; then while carefully compressing piston oil ring (59) with fingers, install piston and rod assembly into cylinder tube (44).

18. Insert new oil passage tube O-ring seal (46) into bore in cylinder cap. Make sure seal is properly seated in groove.

19. Install new cylinder cap O-ring seal (57) into groove of cylinder cap (48), making sure seal ring is well seated into groove.

20. Position cylinder cap (48) over piston rod (45) and against cylinder tube (44), aligning alignment marks on cylinder cap with marks on cylinder tube.

21. Press new piston rod wiper seal (54) in piston rod packing nut (49). NOTE: Install seal with seal lip positioned as shown in figure 10.

22. Position one new piston rod packing inner adapter (76), five piston rod chevron packing (55), and one piston rod packing outer adapter (50) over end of piston rod (45) and into cylinder cap (48).

IMPORTANT: Adapters and packing must be positioned as shown in figure 10.

23. Place piston rod packing nut (49) over end of piston rod and on cylinder cap (48). Tighten packing nut to dimension shown in figure 10. Install new lock wire (8) later. NOTE: Piston rod packing nut (49) should not be tightened excessively, as piston rod (45) and piston (58) should slide freely in cylinder tube (44) with hand pressure of approximately 35 pounds of force.

24. Insert oil passage tube spring (47) in bore of cylinder cap (48).

25. With aligning marks on valve body (75) aligned with marks on cylinder cap (48) and cylinder tube (44), move valve body against cylinder tube, at the same time inserting oil passage tube (43) into bore of valve body (75), and bore in cylinder cap (48) against oil passage tube spring (47).

26. Place ball stud body (34) and parts against valve body (75), aligning marks on ball stud body with marks on valve body. Make certain aligning marks on ball stud body (34), valve body (75), cylinder tube (44), and cylinder cap (48) are in alignment; then install four thru bolts (25), and four thru bolt nuts (24) connecting the assembly. Tighten nuts on bolts alternately and evenly until assembly is securely held together. Torque nuts to 20 to 25 foot-pounds.

27. Install new lock wire (8) around one thru bolt and through hole in packing nut as shown in figure 10.

28. While holding piston rod (45) with a 1-inch open end wrench, turn piston rod end socket (52) on piston rod (45) and adjust for length as described later under "Booster Cylinder Piston Rod End Socket."

29. At this stage of assembly, cylinder control valve should be adjusted. Suspend cylinder assembly horizontally under coach; then connect fluid lines to unit. Proceed with Step 4 under "Control Valve Adjustment" explained previously to adjust valve and to complete assembly of cylinder. If valve is not to be adjusted at this time, continue assembly procedures outlined below:

30. Install ball stud seat (31), ball stud (2), ball stud seat (72), ball stud spring (30), and ball stud plug (73) in ball stud sleeve (32). Tighten plug (73) against spring solidly; then back off to first key slot in ball stud sleeve.

31. Position ball stud plug lock key (74) through

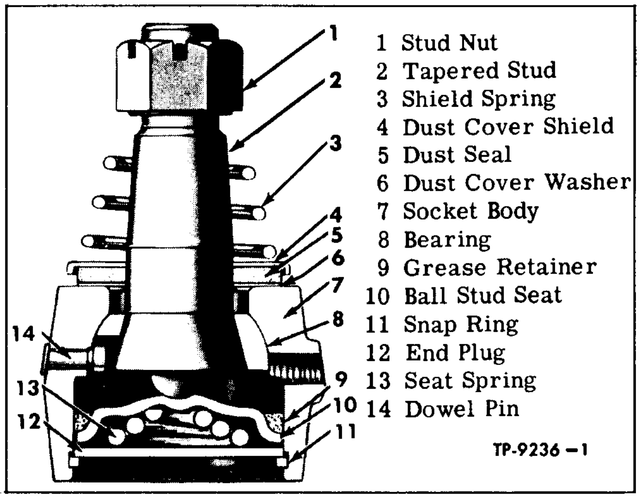


Figure 11—Booster Cylinder Extension End Socket

slots in ball stud plug (73) and ball stud sleeve (32); then install snap ring (29) in groove of ball stud plug (73) to hold lock key (74) in place.

32. Using snap ring pliers, install snap ring (28) in groove of ball stud body (34).

33. If steering booster cylinder assembly is not to be installed on coach immediately after overhaul procedures have been completed, install drag link dust cover (3), dust cover spring (27), and stud nut (1) on ball stud (2), so these parts will not become lost before cylinder is to be installed.

BOOSTER CYLINDER EXTENSION AND END SOCKET

The booster cylinder extension assembly is two-piece type, composed of an extension and an end socket assembly. Extension is flanged at end which attaches to booster cylinder and threaded at opposite end for attachment of end socket assembly.

End socket stud is held against a tapered bearing by a seat and spring. An end plug and snap ring hold these parts in their correct relative position in end socket (fig. 10).

MAINTENANCE

Tapered stud nut must be kept tight, as any looseness of stud at steering arm will cause hole in arm to become enlarged and result in premature replacement of parts. Tightening stud nut after wear has occurred will result in damage to dust covers and springs, particularly when turning to extreme right and left.

Normal wear on bearing surfaces in end socket will cause increase in overall height of assembly. If excessive play is noted, it is evident that worn parts or complete end socket assembly must be replaced.

At intervals indicated, apply recommended lubricant as directed in LUBRICATION (SEC. 13) of this manual.

REMOVAL

1. Remove cotter pin and nut attaching tapered end socket stud to right-hand steering arm. Strike steering arm a sharp blow with hammer as downward pressure is applied at end socket to remove stud from arm.

2. Remove four cotter pins, nuts, and bolts attaching extension to booster cylinder assembly. Discard cotter pins.

INSTALLATION

1. With the two clamp bolts loose, turn end socket onto extension until dimension from center line of tapered stud to face of extension is 19.70". Do not tighten bolts until installation is complete.

2. Attach extension flange to booster cylinder flange using four bolts and nuts. Tighten nuts securely; then install new cotter pins to secure nuts.

3. Position dust cover washer, dust seal, dust cover seal, and spring over end socket tapered stud. Attach tapered stud to steering arm with nut and new cotter pin. Tighten end socket clamp bolts securely.

DISASSEMBLY

Key numbers in text refer to figure 11.

1. Remove extension and end socket assembly as previously instructed. Loosen two clamp bolts and nuts, then thread end socket assembly off extension. NOTE: If end socket body is not being repaired or replaced, there is no need for removal from extension.

2. Remove shield spring (3), dust cover shield (4), dust seal (5), and dust cover washer (6) from tapered stud (2).

3. Remove snap ring (11), end plug (12), seat spring (13), stud seat (10), and grease retainer (9). When these parts are removed, tapered stud (2), and bearing (8) can easily be removed from end socket.

CLEANING AND INSPECTION

Immerse all parts in suitable cleaning solution to loosen and remove all accumulated dirt and grease. Use stiff bristle brush and repeat immersions until all parts are clean.

Inspect all parts for evidence of excessive wear or corrosion. Inspect springs for loss of tension and broken coils. Discard seal and grease retainer. Replace defective and excessively worn parts wherever necessary.

ASSEMBLY

Key numbers in text refer to figure 11.

1. During assembly procedures, lubricate

parts with lubricant recommended in LUBRICATION (SEC. 13) of this manual.

2. Install bearing (8) into end socket with slot over rivet head. Install tapered stud (2).

3. In the order listed, install the following parts into end socket: grease retainer (9), stud seat (10), seat spring (13), end plug (12), and snap ring (11).

4. If removed, install lubrication fitting and fill with recommended lubricant.

5. Position dust cover washer (6), dust seal (5), dust cover shield (4), and shield spring (3) on tapered stud (2); then until ready to install the assembly on coach, install stud nut (1) to retain parts.

6. If socket end assembly was removed from extension, thread end socket on extension to a dimension of 19.70". Dimension is measured from centerline of tapered stud to face of extension (fig. 9).

BOOSTER CYLINDER PISTON ROD END SOCKET

Power steering booster cylinder piston rod end socket is of the same construction as booster cylinder extension end socket (fig. 11). Piston rod end socket threads directly on piston rod installed in booster cylinder assembly. Refer to "Booster Cylinder Extension and End Socket" described earlier in this section for overhaul procedures.

REMOVAL

1. Remove cotter pin and stud nut attaching piston rod end socket stud to suspension support bracket. Using a puller, force socket stud from bracket.

2. Remove set screw, then loosen socket end clamp bolt. Thread socket end assembly off piston rod.

3. Procedures required to overhaul booster cylinder piston rod end socket are the same as described previously under "Booster Cylinder Extension and End Socket."

INSTALLATION

1. Compress booster cylinder assembly into fully retracted position; then thread booster cylinder piston rod end socket on piston rod to a dimension of 26-25/32" measured from centerline of end socket tapered stud to centerline of booster cylinder ball stud.

2. When booster cylinder is correctly adjusted, install set screw and clamp bolt. Tighten clamp bolt to 100 foot-pounds torque. Stake set screw in three places.

3. Reinstall piston rod end socket to suspension support bracket. Tighten stud nut to 150 foot-pounds torque. Secure nut with new cotter pin.

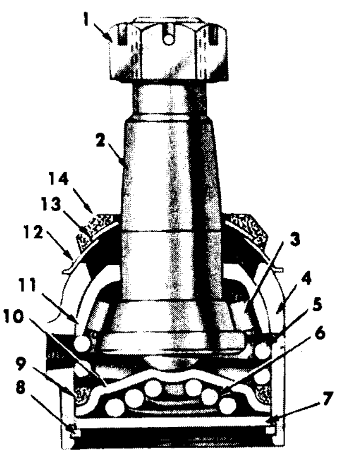


Figure 12—Power Steering Drag Link End Socket

POWER STEERING DRAG LINK

Adjustable steering drag link assembly used with power steering is composed of two parts, drag link and end socket assembly (fig. 12). Drag link end socket assembly is roller-bearing type incorporating adjustable features which automatically compensates for normal wear. End socket assembly at Pitman arm end of drag link assembly threads on drag link and provides for length adjustment. End socket assembly is secured to drag link by two clamp bolts, nuts, and lock washers. Opposite end of drag link engages booster cylinder ball stud and is secured by a stud nut and cotter pin.

MAINTENANCE

If steering linkage between the steering gear and front axle is out of adjustment, bent, twisted, or worn, steering action of coach will be seriously affected. At any time steering linkage parts are repaired, replaced, or adjusted, steering geometry and front wheel alignment must be checked. Refer to FRONT AXLE (SEC. 1) of this manual for procedures.

Stud nuts at socket end and booster cylinder ball stud end of drag link must be kept tight or hole at ball stud end of drag link and hole in Pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs into holes so far that dust cover parts may become damaged and result in premature replacement.

Drag link end socket is equipped with lubrication fittings and should be lubricated at regular intervals as directed in LUBRICATION (SEC. 13) of this manual.

DRAG LINK ADJUSTMENT

Drag link is adjusted properly when steering wheel is centered an equal number of turns between extreme right or left position, and the front wheels are positioned straight ahead. In this position the centerline of hole at drag link end of the Pitman arm will be 1/2" to the left of centerline of coach when viewed from rear of front axle (fig. 9). NOTE: Centerline of coach can be identified by prick punch marks on back of front axle beam.

1. If drag link needs adjustment, disconnect drag link at Pitman arm.

2. Loosen clamp bolts securing end socket to drag link. With Pitman arm positioned to dimension stated above (fig. 9) and front wheels straight ahead, turn end socket on drag link as required to align center of end stud with center of hole in Pitman arm. Attach end socket to Pitman arm. Tighten stud nut to 150 foot-pounds torque; then install new cotter pin.

IMPORTANT: Booster cylinder end of drag link must be tilted to same plane as flange of cylinder ball stud body before clamp bolts at Pitman arm end socket are tightened. Rotate link if necessary; then tighten clamp bolts and nuts firmly to 100 foot-pounds torque.

DRAG LINK END SOCKET REPLACEMENT

Refer to "Steering Drag Link Adjustment" preceding for preliminary procedures which will apply for replacement of drag link end socket. In addition to adjustment procedures, remove end socket from drag link.

DRAG LINK END SOCKET OVERHAUL

DISASSEMBLY

Key numbers in text refer to figure 12.

1. Remove outer dust seal cover (14), outer dust seal (13), and inner dust seal cover (12) from end socket tapered stud.

2. Position end socket assembly in vise and press end plug (7) in against spring pressure far enough to remove end plug lock (8) by using a screwdriver to pry lock out of groove in socket end (4).

3. Remove end plug (7), end stud seat spring (6), end stud seat (10), grease retainer (9), socket centering spring (5), tapered end stud (2), end stud bearing (3), and end stud bearing seat (11) from drag link socket end (4).

CLEANING AND INSPECTION

Key numbers in text refer to figure 12.

1. Clean all parts except outer dust seal cover (14) thoroughly in cleaning solvent. Wipe or blow parts dry.

2. Inspect all parts for corrosion and excessive wear. Discard all parts not in good condition.

3. Check socket centering spring (5) and end stud seat spring (6) for free length, compressed length, distortion, or collapsed coils.

4. Inspect bearing rollers in end stud bearing assembly (3) for roughness or flaking. If rollers will not rotate freely in retainer, replace bearing assembly.

5. Discard dust seal, dust covers, and grease retainer.

ASSEMBLY

Key numbers in text refer to figure 12.

When assembling adjustable drag link end socket assembly, be sure all parts and working area are thoroughly clean. If dirt or foreign matter is allowed to get into drag link end socket assembly, excessive wear and premature replacement of parts will be the result. Lubricate each part with lubricant specified in LUBRICATION (SEC. 13) of this manual as part is installed.

1. Position end stud bearing seat (11) and stud bearing (3) on tapered end stud.

2. Insert stud and bearing assembly into drag link socket end (4).

3. Position socket centering spring (5) in socket end (4) against end stud bearing seat (11).

4. Press new grease retainer (9) over end stud seat (10); then position retainer and seat in socket end (4).

5. Install end stud seat spring (6), and end plug (7) in socket end (4).

6. With end socket assembly positioned in vise, apply pressure against end plug to compress springs; then install end plug lock (8) in groove of socket end (4).

7. Position inner dust seal cover (12), outer dust seal (13), and outer dust seal cover (14) over threaded end of tapered end stud.

8. With drag link end socket assembly cleaned, inspected, and repaired, assemble to drag link and adjust as directed previously under "Drag Link Adjustment."

POWER STEERING HYDRAULIC PUMP

The power steering pump (fig. 17) is a vane type, self-contained hydraulic unit which supplies hydraulic power for operation of the steering booster cylinder at front axle. Pump is mounted at rear of engine (fig. 1), and is driven by the blower drive shaft through a coupling (fig. 16).

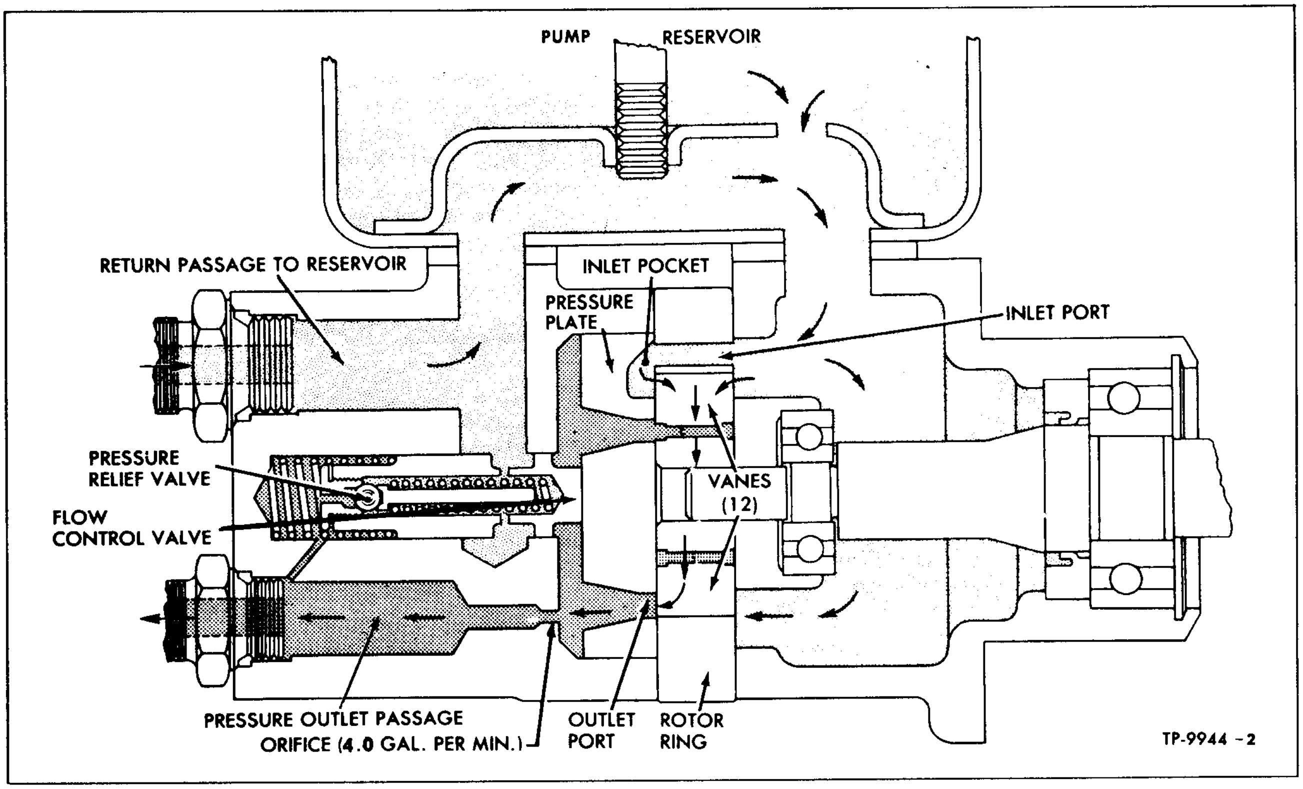


Figure 13—Fluid Flow in Pump with Low Vehicle Speed and Partial Turn (Typical)

OPERATION

Hydraulic fluid from pump reservoir enters pump body and is picked up by rotor vanes through inlet ports and pockets, then discharged under pressure through outlet ports in pump pressure plate. Fluid under pressure is also directed through another passage in pressure plate so it enters behind rotor vanes, forcing vanes to follow eccentric contour of rotor ring. Remainder of fluid is directed through an orifice in pressure outlet.

Orifice in pressure outlet is calibrated so pump output in excess of 4.0 gallons per minute will cause back pressure. This back pressure opens flow control valve against spring pressure, allowing excess fluid to return to pump reservoir.

If pressure in control valve reaches 950-1000 psi maximum pressure, relief valve will open against spring pressure to limit maximum fluid pressure. When pressure relief valve opens, it allows fluid in pressure outlet passage to pass through flow control valve into pump reservoir.

Fluid flow, as shown in figure 13, is typical of pump operation when coach is driven at low speed during a partial turn. Fluid pressure cannot become high enough to open relief valve, because the valve spool in control valve is still partially open, allowing some fluid to return to pump reservoir. Also, due to low pump speed, fluid pressure is not great enough to open flow control valve.

Figure 14 typically shows operation of steering pump flow control valve and pressure relief valve when coach is driven in full turn at low speed. In this instance, maximum pump pressure is being applied to booster piston to assist in turn and valve spool stops flow of fluid to pump reservoir. High fluid pressure that develops opens both flow

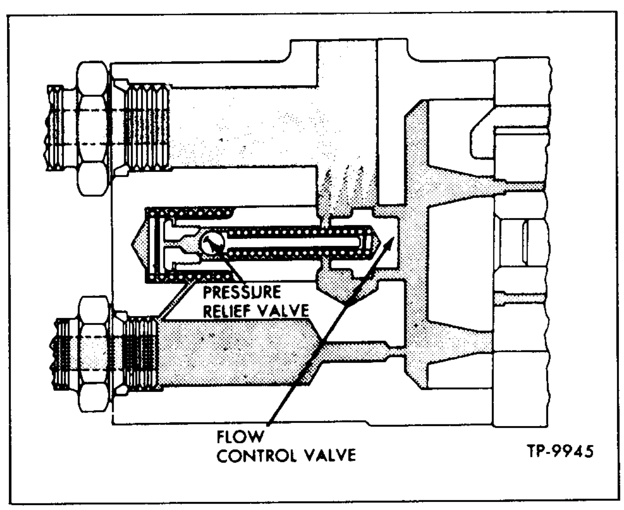


Figure 14—Flow Control Valve and Pressure Relief Valve Operation at Low Speed in Full Turn (Typical)

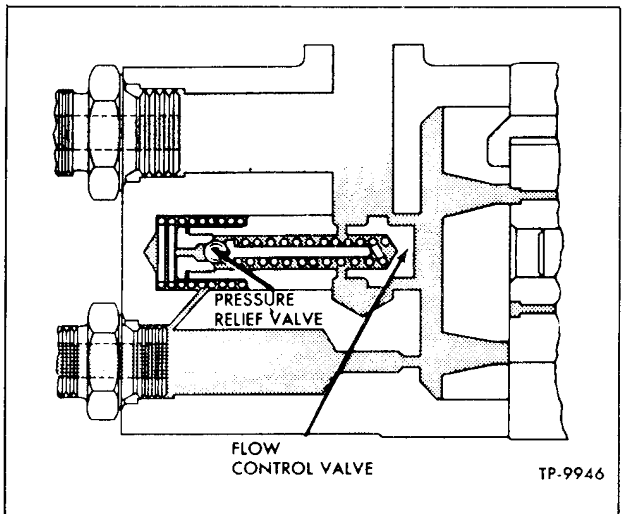


Figure 15—Flow Control Valve Operation At High Vehicle Speed (Typical)

control valve and pressure relief valve which limits pressure by allowing the fluid to return to pump reservoir.

Figure 15 is a typical illustration of operation

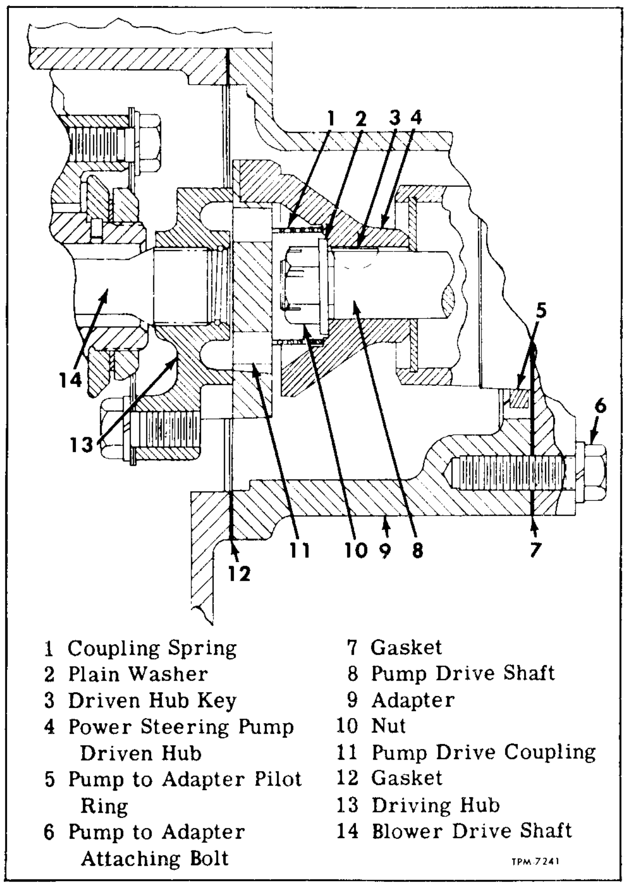


Figure 16—Power Steering Pump Drive

of flow control valve when coach is driven at high speeds. Pump output exceeds 4.0 gallons per minute, which opens flow control valve allowing fluid to return to pump reservoir. When operating coach at high rate of speed on straight-ahead driving or partial turns, valve spool in control valve is open also allowing fluid to return to pump reservoir. As long as valve spool remains open, pressure build-up will not be sufficient to open pressure relief valve.

HYDRAULIC PUMP REPLACEMENT

REMOVAL

Key numbers in text refer to figure 16.

1. Place a clean pan under power steering pump pressure and return flexible lines and pump parts to catch hydraulic fluid; then remove lines from pump by unscrewing fittings.
2. Remove bolts, nuts, and lock washers attaching power steering pump and adapter assembly to engine flywheel housing.
3. Using care to avoid dropping coupling ring (11) and coupling spring (1), remove pump and adapter assembly from engine.
4. Remove coupling ring (11) and coupling spring (1); then remove adapter to housing gasket (12). Discard gasket.
5. Remove lock nut (10) and plain washer (2) attaching driven hub (4) to pump drive shaft (8).
6. Remove two bolts (6) and lock washers attaching pump to adapter.
7. Remove adapter (9), adapter pilot ring (5), and gasket (7) from pump. Discard gasket.

INSTALLATION

1. If previously removed, install Woodruff key (3) in slot of pump drive shaft (8).
2. Position pump driven hub (4) on pump drive shaft (8), aligning Woodruff key in drive shaft with slot in hub (4).
3. Install lock nut (10) and plain washer (2) attaching pump driven hub (4) to pump drive shaft (8). Tighten nut to 55 foot-pounds torque.
4. Position adapter pilot ring (5) in the adapter (9); then attach adapter and new gasket (7) to pump with two bolts and washers.
5. Install coupling spring (1) and coupling ring (11) in pump adapter, engaging prongs of driven hub (4) with slots in coupling ring (11).
6. Using new adapter to flywheel housing gasket (12), position pump and adapter assembly to flywheel housing, engaging prongs of driving hub (13) with slots in coupling ring (11).
7. Install adapter to flywheel housing, attaching with bolts, nuts, and lock washers. Tighten securely.
8. Connect power steering pump pressure and return flexible lines to pump. Tighten fittings firmly.
9. Refill power steering hydraulic system and

bleed system as described previously under "Bleeding Power Steering Hydraulic System."

HYDRAULIC PUMP OVERHAUL

Overhaul of power steering hydraulic pump must be undertaken in clean working area with pump removed from coach engine. It is important that overhaul procedures described in the following text be carefully followed.

DISASSEMBLY

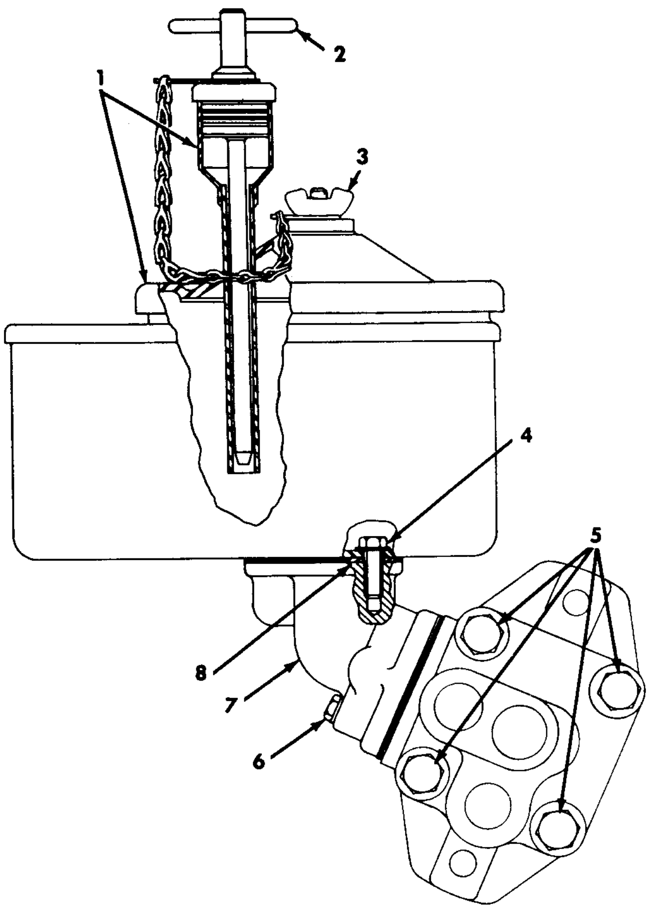
Key numbers in text refer to figure 17.

1. Using a suitable cleaning solvent, thoroughly clean the exterior of the hydraulic pump to prevent entry of dirt or other foreign matter into the pump during overhaul procedures.
2. Remove wing nut (3); then remove dipstick and plug assembly (2) from pump reservoir cover (1).
3. Remove washer (9) and gasket (10) from reservoir cover (1). Discard gasket.
4. Lift reservoir cover and tube assembly (1) and cover gasket (13) from reservoir tank (14). Discard gasket (13).
5. Remove four bolts (4) attaching reservoir tank (14) to pump manifold (7); then remove reservoir tank (14), four spacers (8), and reservoir oil baffle (39).
6. Remove pump manifold to reservoir discharge (15) and return (37) gaskets. Discard gaskets.
7. Remove four manifold to pump attaching bolts (6), and remove manifold (7) from pump body (24) and pump cover (33). Remove manifold to pump discharge (16) and return (34) gaskets. Discard gaskets.
8. Remove four bolts (5) attaching pump cover (33) to pump body (24); then remove pump cover from pump body.
9. Lift flow control valve assembly (28), flow control spring (29), and seal ring (36) from pump cover (33). Discard seal ring (36).
10. If inspection shows necessity for removal, remove snap ring (32); then drive spring retainer plug (31) and seal ring (30) from pump cover (33). Discard seal ring (30).
11. Mark position of pressure plate (35) so it can be reassembled in same relative position; then remove pressure plate from locating pins (25) which extend through pump body to cover ring (26).
12. Mark position of pump body to cover ring (26) so it can be reassembled in same position in relation to pump body (24); then lift ring from locating pins (25).
13. Remove pump rotor (27), 12 rotor vanes (17), and seal ring (36) from pump body (24). Discard seal ring (36).
14. If inspection shows necessity for removal of locating pins (25), remove pins from pump body.
15. Using needle nose pliers, remove drive shaft bearing snap ring (21) from pump body (24).
16. Pull drive shaft outer bearing (22) and drive shaft (20) from pump body (24). It may be necessary to tap on end of drive shaft with plastic hammer to facilitate removal.
17. If inspection indicates necessity for removal of bearing oil seal (23) and drive shaft inner bearing (18), drive seal out of pump body with punch and hammer; then using care to avoid damage to inner surface of pump body, remove inner bearing from pump body by tapping out lightly with hammer and brass drift.
18. Remove drive shaft key (19) from slot in rotor drive shaft (20).
19. If inspection indicates necessity for replacement of outer bearing (22), press bearing off drive shaft (20) using a 1" I.D. sleeve.
20. If flow control valve assembly (fig. 18) is to be disassembled for inspection or cleaning purposes, maintain pressure on spring loaded plug to prevent loss of poppet relief ball. Be careful not to score ground surfaces of flow control valve.
21. Flexible line union fittings in pump cover should not be removed unless inspection indicates O-ring seals leak or fittings are damaged.

CLEANING AND INSPECTION

Key numbers in text refer to figure 17.

1. Clean all parts except drive shaft outer (22) and inner (18) bearings in cleaning solvent. Wipe parts dry with clean lint-free cloth. NOTE: Drive shaft outer bearing (22) is a sealed and shielded ball bearing. Washing bearing in solvent may dilute lubricant sealed into bearing.
2. Rotate bearings slowly by hand, feeling for roughness. Do not mistake dirt or grit in bearing for roughness. Examine bearings for wear or damaged balls. Replace bearings if not in good condition.
3. Check fit of vanes (17) in slots in rotor (27) for tightness or excessively loose condition. Vanes must slide freely but fit snugly in slots in rotor. Tight fit of vanes in rotor may sometimes be corrected by thorough cleaning. Replace rotor if excessive looseness exists between rotor and vanes. Replace vanes if worn or scored.
4. Examine machined surfaces of pump body (24) to cover ring (26) for roughness or excessive wear. Replace ring if condition cannot be corrected with crocus cloth.
5. Inspect machined surfaces of pressure plate (35) and pump body for wear or scoring. Slight wear or scoring may be cleaned up by lapping. Lapping compound must be thoroughly washed off parts before they are reinstalled.
6. Inspect machined surfaces of flow control valve (28) for scoring or roughness. Check for free-



1 Cover and Tube Assembly
2 Dipstick and Plug Assembly
3 Cover Bolt Wing Nut
4 Reservoir to Manifold Attaching Bolt
5 Pump Cover to Body Attaching Bolts
6 Manifold to Pump Attaching Bolt
7 Pump Manifold
8 Gasket Spacer
9 Reservoir Cover Bolt Washer
10 Gasket
11 Cover Bolt Guide
12 Reservoir Cover Bolt
13 Cover Gasket
14 Reservoir Tank
15 Manifold to Reservoir Discharge Gasket
16 Manifold to Pump Discharge Gasket
17 Rotor Vane
18 Rotor and Drive Shaft Inner Bearing
19 Woodruff Key
20 Pump Drive Shaft
21 Snap Ring
22 Rotor and Drive Shaft Outer Bearing
23 Drive Shaft Oil Seal
24 Pump Body
25 Locating Pin
26 Pump Ring
27 Rotor
28 Flow Control Valve
29 Flow Control Valve Spring
30 O-ring Seal
31 Flow Control Spring Plug
32 Snap Ring
33 Pump Cover
34 Manifold to Pump Return Gasket
35 Pressure Plate
36 O-ring Seals
37 Manifold to Reservoir Return Gasket
38 Cover Plate
39 Oil Baffle

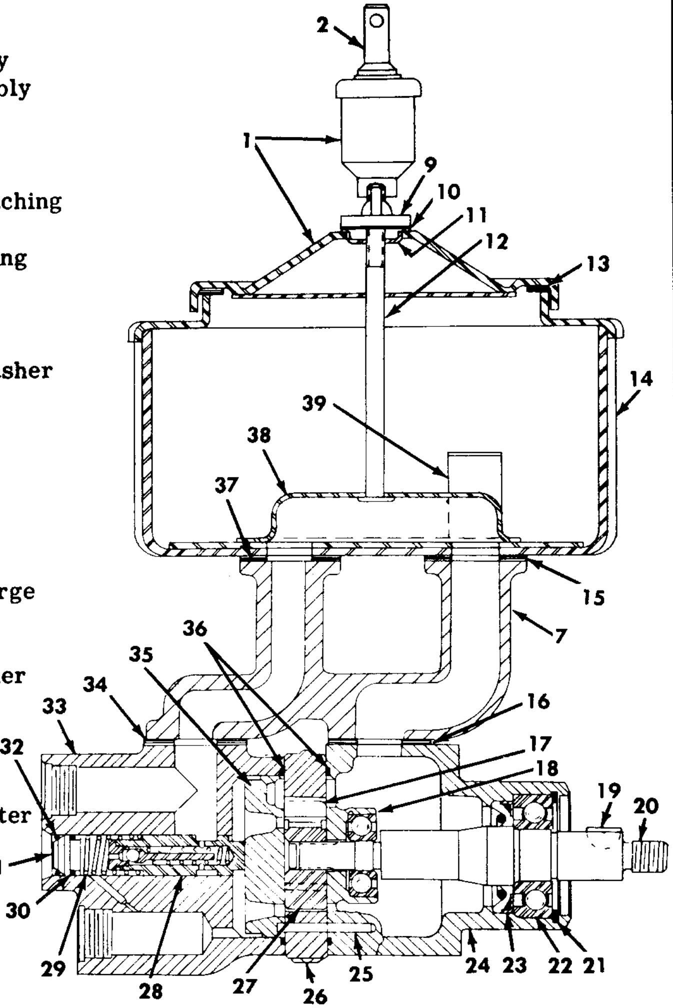


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Figure 17—Power Steering Hydraulic Pump

dom of movement of valve in bore of pump cover. Slight wear, nicks, or scores may be corrected with crocus cloth.

7. Make sure calibrated orifice in flow control valve plug is open.

8. Check flow control valve spring and relief valve spring for free length, compressed length, distortion, or collapsed coils. (See Specifications.)

9. Inspect oil passages in pump body, cover, pressure plate, and cover to body ring for obstructed passages. Clean passages if this condition is found.

10. Check locating pins (25) for distortion.

ASSEMBLY

Key numbers in text refer to figure 17.

Lubricate each moving part with clean recommended hydraulic fluid before part is installed. When assembling power steering pump, use new gaskets and O-ring seals.

1. If flow control valve assembly (fig. 18) has been disassembled, assemble parts, making sure same number of shims are installed as were removed. These shims control pressure at which relief valve opens to 950-1000 psi pressure. Tighten relief valve adjusting screw to 80-100 inch-pounds torque.

2. If drive shaft outer bearing (22) was removed from drive shaft (20), press bearing on shaft, using a sleeve with 1" I.D. Install bearing on shaft with stamped face of inner race toward threaded end of shaft.

3. If drive shaft inner bearing (18) was removed from pump body (24), install bearing in pump body by tapping lightly on bearing outer race. Make sure bearing is fully seated in pump body.

4. If bearing oil seal (23), was previously removed from pump body (24), install new oil seal in bore of pump body. Use a sleeve with 1-5/8" diameter to bear against outer edge of seal when driving into position. Install seal with stamped side facing out. Make sure seal is properly seated in pump body.

5. Install drive shaft (20) and outer bearing (22) in bore of pump body (24). Tap lightly on outer race of bearing until bearing is fully seated; then install snap ring (21) in pump body.

6. If locating pins (25) were removed at pump disassembly, install new pins in pump body (24).

7. Install new sealing ring (36) in groove of pump body (24).

8. Install pump rotor (27) over splines of drive shaft (20); then position vanes in slots in rotor with beveled edges of vanes facing seal ring (36).

9. Carefully position pump body to cover ring (26) over pump rotor (27) and vanes (17) in alignment with mark made at disassembly. NOTE: Observe body to cover ring (26) which has arrows

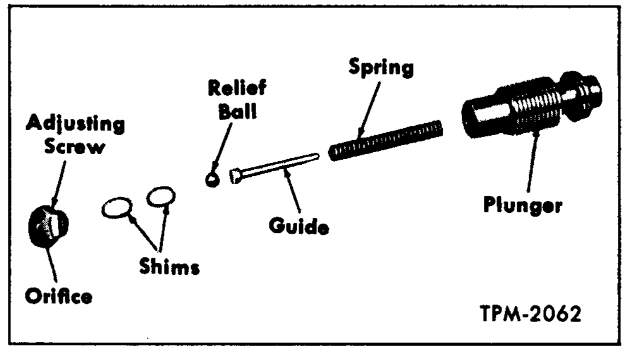

Figure 18—Flow Control Valve

cast onto outer edge. Pump body to cover ring (26) must be positioned on locating pins (25) with these arrows pointed in a counterclockwise direction when pump is viewed from the drive end.

10. Position pressure plate (35) over locating pins (25) and against pump body to cover ring (26) in alignment with marks made at disassembly.

11. Place new O-ring seal (36) around pressure plate surface of pump body to cover ring (26).

12. Install new seal ring (30) in groove of spring retainer plug (31); then install plug into bore of pump cover (33). Secure plug with snap ring (32).

13. Position flow control valve spring (29) and flow control valve (28) in bore of pump cover (33).

14. Place pump cover (33) over pressure plate (35) and against pump body to cover ring (26), aligning pump cover with pump body.

15. Install four bolts (5) attaching pump cover to pump body. Tighten bolts evenly to 25-30 foot-pounds torque. Turn pump rotor drive shaft to check for freeness.

16. Install drive shaft key (19) in slot of rotor drive shaft (20). Secure with tape.

17. If flexible line union fittings and O-ring seals were removed from pump, install new seals and fittings in pump cover. Plug or mask fittings to keep dirt or foreign material out of pump until pump is ready to be installed on engine.

18. Position new manifold to pump discharge (16) and return (34) gaskets on pump assembly; then attach pump manifold (7) to pump with four attaching bolts. Tighten bolts to 3.5 to 4.0 foot-pounds torque.

19. Position new manifold to reservoir discharge (15) and return (37) gaskets on manifold; then position reservoir tank (14) on manifold (7).

20. Position oil baffle (39) over discharge hole at bottom of reservoir tank (14); then install four attaching bolts (4) and spacers (8). Tighten bolts to 3.5 to 4.0 foot-pounds torque.

21. Place reservoir cover (1) and tube assembly and new gasket (13) on reservoir tank.

22. Position new gasket (10) and washer (9)

over reservoir cover bolt:

23. Install dipstick and plug assembly (2) in reservoir cover and tube assembly.

24. Position chain on dipstick and plug assembly over reservoir cover bolt; then install wing nut on bolt. Tighten wing nut firmly.

POWER STEERING FLUID FILTER

Power steering fluid filter assembly is bracket mounted to engine bulkhead (fig. 4).

At regular lubrication intervals, fluid filter bowl should be removed and element cleaned. Any time power steering fluid filter has been serviced, power steering hydraulic system should be bled. Refer to "Bleeding Power Steering Hydraulic System" explained earlier in this section.

SERVICING FILTER

NOTE: The filter assembly can be serviced without removing complete assembly from coach.

1. Using a wrench, turn filter bowl out of threads of filter head.
2. Remove and discard filter bowl gasket.
3. With a small wrench, unscrew filter element assembly from filter head. Use care to avoid damage to element. Clean parts, using cleaning solvent and compressed air.
4. Remove fluid filter drain plug from bottom of filter bowl. Clean all metallic material from plug magnets.
5. Reassemble filter; then bleed hydraulic system as directed earlier under "Bleeding Power Steering Hydraulic System."

POWER STEERING SYSTEM SPECIFICATIONS

HYDRAULIC PUMP

Make	Vickers
Model	VT36-100-40-95-40-10S4—L.H.
Type	Hydraulic Vane
Capacity	4 Gal. per Minute at 1200 R.P.M. and Zero Pressure
PUMP ROTOR	
Width	0.6139″
Outside Diameter	1.588″-1.598″
Number Vane Slots	12
Vane Slot Width	0.0780″-0.0785″
ROTOR VANES	
Quantity	12
Thickness	0.0775″
Width	0.0343″
Length	0.6136″
OUTER BEARING	
Type	Single Row Ball
Make	N.D.-954211
Outside Diameter	1.8499″-1.8504″
Inside Diameter	0.7874″-0.7870″
INNER BEARING	
Type	Single Row Ball
Make	N.D.-903201
Outside Diameter	1.2593″-1.2598″
Inside Diameter	0.4721″-0.4724″
Flow Control Valve	
Opening Pressure	950 to 1000 psi
Shim Thickness	0.030″ and 0.045″
Springs	
Flow Control Valve Spring	
Free Length	2.506″
Compressed Length Under 6.25 lbs.	0.906″
7.7 lbs.	0.531″
Relief Spring	
Free Length	1.591″
Compressed Length Under 19.6 lbs.	1.3125″
21.78 lbs.	1.2812″

POWER STEERING BOOSTER CYLINDER

Make	Vickers
Model	SP3-210B
Type	Hydraulic
Adjustable Length (Disconnected and Fully Retracted) Center of Stud at Each End	26 25/32″
Cylinder Tube—Inside Diameter (Low Limit Preferred)	2.750″-2.756″
Outside Diameter	3 1/8″
Length	14 23/32″
Piston	
Outside Diameter	2.748″
Clearance—Piston to Cylinder	0.002″-0.010″
Ring Groove—Width	0.187″-0.188″
Depth	1/8″
Piston Ring	
Width	0.1860″-0.1865″
Wall Thickness	0.103″-0.113″
Outside Diameter (When Compressed)	2.750″
Gap (When Compressed to 2.750″)	0.007″-0.017″
Piston Rod	
Finish	Chrome Plated
Stroke	12 1/2″
Diameter	1.1245″
Piston Rod Bushing (In Cylinder Cap)	
Inside Diameter	1.128″-1.129″
Outside Diameter	1.378″-1.379″
Width	1.120″-1.130″
Booster Cylinder Extension and End Socket Adjusted Length (Centerline of End Socket Tapered Stud to Outside Edge of Flange)	19.70″ ± 0.3″
Springs	
Valve Centering Spring (Outer)	
Free Length	1.293″
Compressed Length Under 160 lbs.	1.093″
Compressed Length Under 260 lbs.	0.968″
Valve Centering Spring (Center)	
Free Length	1.044″
Compressed Length Under 106 lbs.	0.843″
Compressed Length Under 172 lbs.	0.718″
Valve Centering Spring (Inner)	
Free Length	1.042″
Compressed Length Under 54 lbs.	0.843″
Compressed Length Under 88 lbs.	0.718″
Check Valve Ball Spring	
Free Length	1.059″
Compressed Length Under 0.4 lbs.	7/8″
Oil Passage Tube Spring	
Free Length	0.536″
Compressed Length Under 9 lbs.	0.375″

POWER STEERING SYSTEM SPECIFICATIONS (CONT.)

POWER STEERING BOOSTER CYLINDER (Cont.)

Steering Booster Ball Stud Outer Seat Spring
Free Length .... 23/32"
Compressed Length Under 185-238 lbs. .... ½"

R.H. Socket Stud Spring
Free Length .... 1.25"
Compressed Length Under 250 lbs. .... 0.88"

STEERING GEAR

Make .... Saginaw
Type .... Recirculating Ball and Sector Nut
Gear Ratio .... 25.6 to 1
Model 572-D-3

Adjustments
Worm Bearings
Adjustment Type .... Shims
Shim Sizes Available .... 0.002", 0.005", 0.010", and 0.030".
NOTE: Use a minimum of (3) 0.002" and (2) 0.005" thick shims.
End Play in Worm .... None
Pull to Keep the Worm Moving .... 6¾ to 9 in. lbs.
Pitman Shaft Lash
Adjustment type .... Adjuster Screw
Pull Through Center
(Includes Worm Bearing Load) .... 16 in. lbs. max.
Back-Up Adjuster... Screw in until adjuster bottoms; then back off ¼ turn and tighten lock nut to 30-50 foot-pounds torque.

Reverse torque at Pitman shaft to be 45-60 ft.-lbs. thru center

NOTE: Balance of steering gear specifications are the same as described previously under "Mechanical Steering Specifications."

STEERING DRAG LINK

Type .... Adjustable Length
Length—Stud Centers .... 11 21/64"
Springs
Stud Seat Spring
Free Length .... 0.750"
Compressed Length Under 350-400 lbs. .... 0.500"
Socket Centering Spring
Free Length .... 1.250"
Compressed Length Under 30 lbs. .... 0.875"

TORQUE SPECIFICATIONS

Location	Ft.-Lbs.
Relief Valve Adjusting Screw	80-100 in. lbs.
Pump Reserve to Manifold Bolt	3½-4
Manifold to Pump Bolt	3½-4
Cover to Pump Body Bolt	25-30
Booster Cylinder Flange to Extension Flange Bolts and advance torque to nearest cotter pin hole	40-50
Drag Link to Booster Cylinder Ball Stud Nut and advance in torque to nearest cotter pin hole.	150
Piston Rod End Socket Stud to Support Bracket Stud Nut and advance in torque to nearest cotter pin hole.	150
Extension End Socket Stud to Steering Arm Nut and advance in torque to nearest cotter pin hole.	150
Drag Link Stud to Pitman Arm Nut and advance in torque to nearest cotter pin hole.	150
Piston Rod End Socket to Piston Rod Bolt	100

NOTE: Balance of torque specifications are listed previously in this section under "Mechanical Steering System Specifications."

Refer to LUBRICATION (SEC. 13) for steering system lubrication points and intervals of application.

Use only the fluid recommended in LUBRICATION (SEC. 13) in Power Steering System.

Transmission
(SPICER MODEL 7145VC)

DESCRIPTION

GENERAL

Transmission is four-speed mechanical type mounted directly to engine. Power input is through 63-degree angle drive gears which are enclosed in a portion of the clutch housing. Clutch housing, transmission case and control cover are of cast aluminum alloy. Cast iron inserts are employed where additional strength is required. Angle drive gears are spiral bevel type. All mainshaft, countershaft and reverse idler gears are constant mesh type with helical teeth.

The transmission gears are shifted manually through use of gearshift lever located at right of driver's seat and connected to levers on transmission by rods and bell cranks (figs. 4 and 5).

Shift forks in transmission cover (fig. 15) engage sliding clutches (fig. 12) and the clutches lock gears to respective shafts to provide the power train for each speed.

Transmission lubricant is contained in reservoir on bottom of transmission case. Lubricant is circulated to various points by a gear type pump mounted on engine and connected to transmission by flexible lines (fig. 3).

The terms "Front" and "Rear" as used in this section do not refer to mounted position of transmission in coach. "Front" refers to the input or engine end of transmission while "Rear" refers to output or propeller shaft end of transmission.

Figures 1 and 2 show two views of transmission assembly.

The key numbers used in following descriptions refer to figure 13 unless otherwise indicated.

MAINSHAFT, GEARS, AND BEARINGS

Front end of mainshaft (36) is supported by pilot bearing (14) located in pocket in drive gear (15). Mainshaft rear bearing (43) which takes endwise thrust and carries radial load is installed in retainer (44). Rear bearing cap (34) locks bearing outer race in retainer. Lip of oil seal (35) in bearing cap (34) prevents lubricant leakage and seals out dirt. Speedometer drive gear (31) contacts inner race of bearing (43) and gear is locked in place by yoke assembly (41). Speedometer driven gear (42) is installed in bearing cap (34) and is held in

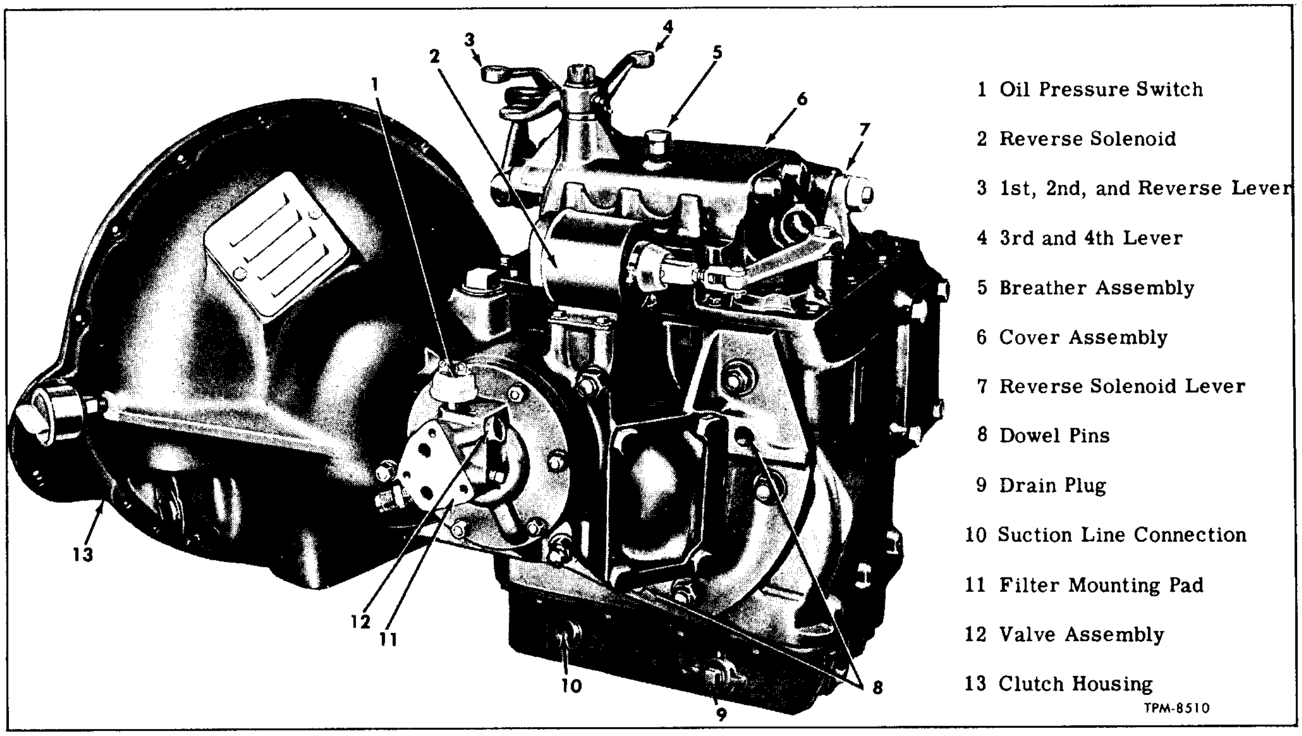

Figure 1—Transmission Assembly Showing Reverse Solenoid and Lever

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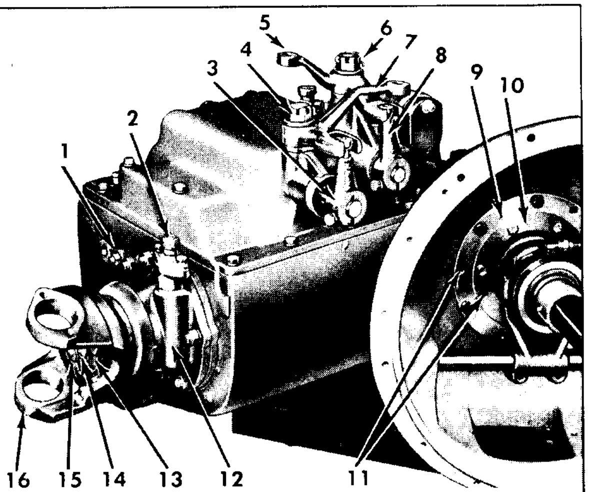

1 Reverse Idler Shaft Lock
2 Speedometer Drive Sleeve
3 1st, 2nd, and Reverse Outer Finger
4 Nut, Washer, and Cotter Pin
5 3rd and 4th Shift Lever
6 Nut, Washer, and Cotter Pin
7 1st, 2nd, and Reverse Lever
8 3rd and 4th Outer Finger
9 Bearing Retainer
10 Pinion Bearing Cap
11 Puller Screw Hole
12 Mainshaft Bearing Cap
13 Washer
14 Cotter Pin
15 Mainshaft Nut
16 Propeller Shaft Yoke

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Figure 2—Transmission Showing Shift Levers and Propeller Shaft Yoke

place by sleeve (2, fig. 2).

Mainshaft 3rd and 4th speed clutch gear (80) is mounted on splined portion of mainshaft and held in place with mainshaft gear retaining nut (16) and lock (81). First and 2nd speed clutch gear is integral with mainshaft.

Mainshaft 1st (21), 2nd (19), and 3rd (18) speed constant mesh gears are each mounted on double row needle bearings. Rows of bearings are separated by spacers.

Oil tube (13) in drive gear (15) supplies lubricant to drilled passage in mainshaft from which lubricant is distributed to bearings and to speedometer gears. Sliding clutch (27) is shifted to provide 1st and second speeds and sliding clutch (79) is shifted to provide 3rd and 4th speeds. Figure 12 shows view of gears in transmission case.

COUNTERSHAFT AND GEARS

Countershaft (52) is supported at rear by single row ball bearing (50) held on shaft with two lock nuts (45 and 51) and nut lock (54). Front end of shaft is supported on countershaft front roller bearing (78) which is prevented from coming out of case by clutch housing (82). Inner race of roller bearing (78) is held on shaft by countershaft nut (77) and retaining washer (76).

Countershaft drive gear (68) and countershaft 3rd speed gear (66) are keyed to shaft and separated by spacer (70). Countershaft 2nd speed gear (72) and countershaft clutch gear are integral with shaft.

Countershaft 1st speed gear (49) is not keyed to shaft, but is carried on bronze bushing (47) and is driven by countershaft sliding clutch (48) carried on countershaft clutch gear. Countershaft sliding clutch is operated by reverse shift fork and is engaged in all forward speeds.

REVERSE IDLER GEAR

Reverse idler driving and driven gears (60 and 64) are mounted on roller bearings, with two rows of bearings in each gear separated by spacers.

Reverse idler gears are separate, revolving independently of each other in all forward speeds. Reverse idler driven gear is in constant mesh with countershaft 2nd speed gear (72) and reverse idler driven gear (60) is in constant mesh with mainshaft 1st speed gear (21). Reverse idler sliding clutch (62) is carried on hub of reverse idler driving gear, and engages both gears during reverse operation (fig. 14). Thrust washers (59 and 65) are installed between respective gears and adjacent portion of transmission case.

DRIVE GEAR AND BEARINGS

Drive gear (15) is supported at transmission case by roller bearing assembly (12). Bearing is held in place by retainer (10) which is bolted to transmission case. Seal prevents leakage between retainer and clutch housing (82). Tapered roller bearings are used at outer end of drive gear. Outer bearings are adjustable, and shims (4) are used to provide proper contact between bevel pinion gear and bevel drive gear (83) keyed to shaft which is integral with drive gear (15). Oil tube (88) carries oil supplied by pump (fig. 3) to lubrication passage in drive gear. Passage is shown by dotted lines. Bearing cap assembly (1) incorporates a lubrication pressure relief valve and is machined for mounting lubricating oil filter assembly.

BEVEL GEARS AND BEARINGS

Key numbers refer to figure 11 unless otherwise indicated.

Bevel drive gear (12) is installed on front end of drive gear (21). Key (7) in drive gear shaft is engaged with keyway in gear. Bevel drive gear (12) is driven by drive pinion (1). Two clutch driven members are installed on splined portion of shaft which is integral with drive pinion (1).

Drive pinion (1) is supported at front end by pilot bearing in engine flywheel. At clutch housing (27) drive pinion (1) is mounted on opposed tapered

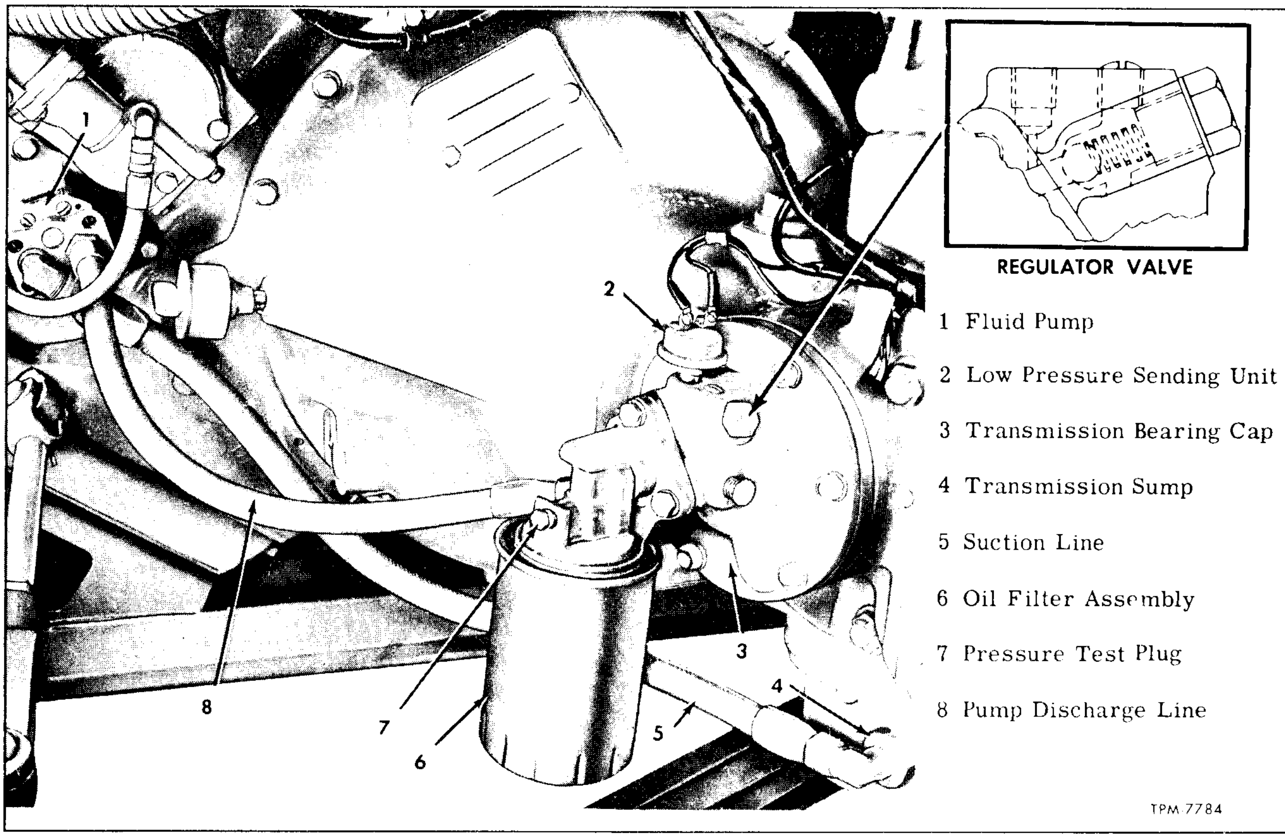


Figure 3—Transmission, Filter, Pump, and Lines

roller bearings which are installed in retainer (3). Spacer (5) and shims provide means for adjusting the bearing pre-load. Nut (35) holds bearings in place on drive pinion. Oil tube (26) pressed into housing (27) carries lubricant to drilled passage in drive pinion to lubricate drive pinion bearings. Shims (16 and 32) are used to adjust gear backlash and gear tooth contact.

COVER, SHIFT LEVERS, AND FORKS

Key numbers refer to figure 15 unless otherwise indicated.

External levers and fingers at transmission cover (14) are operated by transmission gearshift lever and linkage. Inner fingers (7 and 12) engage notches in shift forks. Three shift forks (1, 10, and 13) are clamped to shift rods (15, 16, and 17). Sleeves (5 and 9) on shift rods prevent overshifting, and spring-loaded poppet balls in cover engage notches in top of shift rods to lock the rods into proper position. Interlocks prevent lock-up of transmission by preventing engagement of two gears at once.

Reverse solenoid and lever (2 and 7, fig. 1) move shaft (4) endwise to engage inner finger (12) with notch in fork (13) when shifting into reverse. Spring (11) returns finger (12) to notch in 1st and 2nd shift fork when shifting transmission out of reverse. A breather assembly is installed in transmission cover.

LUBRICATION SYSTEM (Fig. 3)

Lubricant which lubricates transmission is contained in oil reservoir bolted on bottom of transmission case. The pump (fig. 3), is mounted on and driven by the engine. Oil from reservoir is drawn to pump through suction line, and is discharged through line to oil filter assembly on transmission. Located in bearing cap (3, fig. 3) is a spring-loaded pressure regulator valve which maintains pressure at switch (2, fig. 3) at low engine speed. Lubricant is directed through oil passage to lubricate bearings and gears. Lubricant drains through screen (71, fig. 12) into reservoir.

Filter element is disposable type which is screwed onto threaded nipple on filter mounting base. A by-pass valve is provided in filter base to allow oil to by-pass the filter element and continue to lubricate transmission parts in case filter element becomes clogged.

A switch (2, fig. 3) mounted on transmission lights a tell-tale on instrument panel to warn driver in case transmission oil pressure drops below safe operating pressure (1-1/2 to 2-1/2 psi).

TRANSMISSION CONTROLS

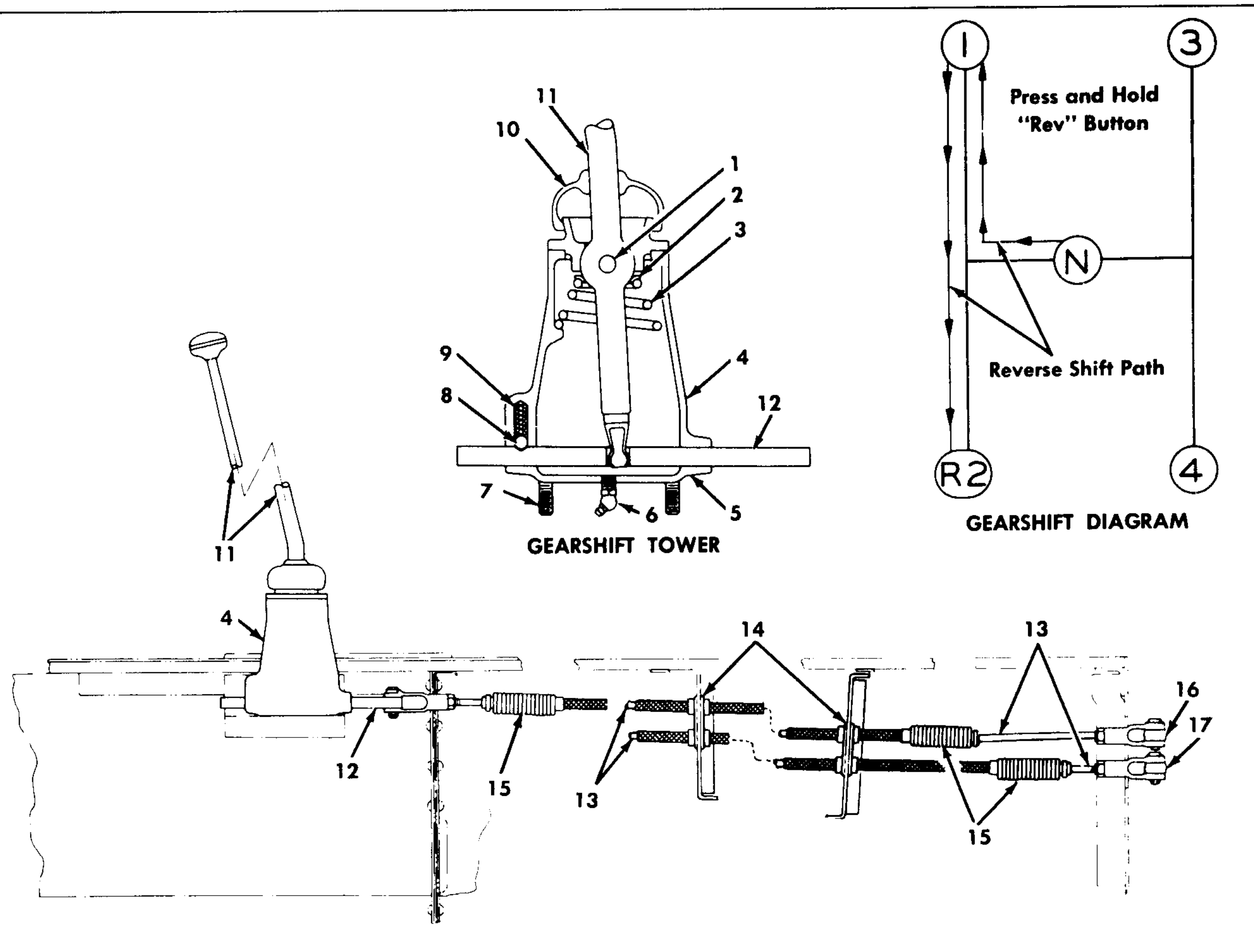
Selection of transmission gear is made by conventional shifting lever. Gearshift lever is mounted in a tower attached under floor near driver's seat. Two shift rails in base of gearshift lever tower are connected with control rods which run from front to rear of coach below floor. Adjustable yokes are provided at both ends of forward rods and also where rear rods are connected with levers at transmission levers.

When shift is made for any one of four forward speeds (fig. 4) the movement of shift lever is transmitted to transmission through various rods, levers, and bell cranks.

Transmission control rods from shifting lever to bulkhead are supported as illustrated in figure 4. Rods pass through loom containing commercial graphite. Figure 5 shows view of bell cranks and rods at engine compartment bulkhead. Rubber grommets are used where rod loom passes through bulkheads and supports.

Reverse solenoid is mounted on transmission and connected to lever (fig. 7) which moves 1st, 2nd, and reverse shaft endwise. Solenoid is energized by a button type switch at panel at left of driver which operates reverse relay located in electrical compartment at R.H. rear corner of coach.

Relay completes circuit to the reverse sole-



1 Lever Ball Pin
2 Spring Seat Washer
3 Lever Spring
4 Control Tower
5 Tower Base
6 Lubrication Fitting
7 Mounting Bolts
8 Shift Rail Poppet Ball
9 Poppet Spring
10 Dust Cover
11 Gearshift Lever
12 Shift Rail (2 Used)
13 Control Rods
14 Grommets
15 Bellows
16 1st, 2nd, and Reverse Bell Crank
17 3rd and 4th Bell Crank

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Figure 4—Transmission Controls

noid. When solenoid is energized, solenoid plunger which is linked to reverse lever (8, fig. 7) pulls on reverse lever and forces shift finger shaft endwise to disengage inner finger from notch in 1st and 2nd fork and engage finger with reverse shift fork. This action can take place only when gearshift lever is in the 1st speed position. Refer to figure 4 for shift diagram.

MAINTENANCE

CONTROL ROD ADJUSTMENT

Key numbers in text refer to figure 4, except as otherwise indicated.

Provisions are made for adjustment of control rod length by use of adjustable yokes. When replacing transmission or any of the control linkage, before attempting to operate vehicle, be sure linkage is adjusted as follows:

1. Place gearshift lever in neutral position and disconnect rods from levers on transmission.
2. With clevises at ends of shift rods (13) connected at both ends, observe position of bell cranks at engine compartment bulkhead (fig. 5) center of clevis pins in clevises (16, fig. 5) must be in line with each other and centered on a line through the two shaft assemblies (1 and 3, fig. 5). If necessary, adjust clevises to bring about the condition described above. Tighten lock nuts at clevises when adjustment is complated.
3. With transmission levers (3 and 4, fig. 1) in neutral position, adjust clevises on bell crank-to-transmission rods (7 and 8, fig. 5) so clevis pins can be installed without moving gearshift lever or transmission shift levers out of neutral position.
4. With engine running, try shifting transmission into each gear. If there is evidence of binding or other difficulty in shifting, make necessary corrections.

CONTROL LUBRICATION

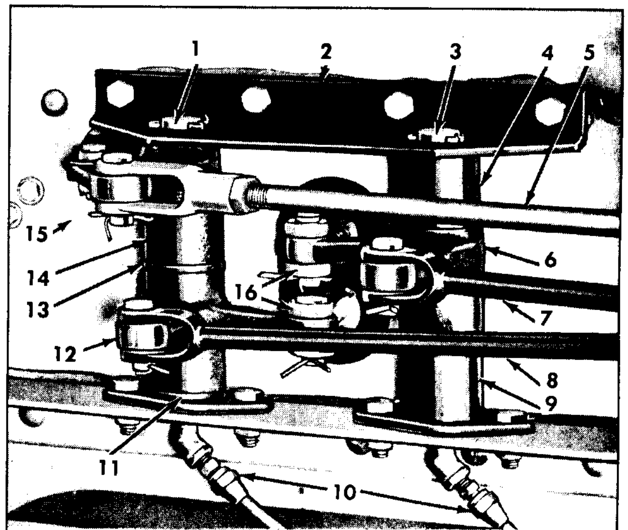
The lubrication fitting at bottom of control tower, fittings at bracket on engine compartment bulkhead, and fittings on levers at transmission cover should be lubricated at intervals specified in LUBRICATION (SEC. 13).

CONTROL TOWER REPLACEMENT

Gearshift lever, mounted in control tower below floor at right of driver can be removed and disassembled as described in these instructions. Refer to figure 4 for layout of control rods.

REMOVAL

1. Open compartment door at left front corner of coach and disconnect clutch pedal return spring from bracket below transmission lever tower.
2. Remove pins which connect control rods to shift slides in base of control tower.



1 Lever Shaft Assy. (L.H.)	9 Lower Spacer
2 Shaft Bracket	10 Lubrication Pipes
3 Lever Shaft Assy. (R.H.)	11 Spacer Washer
4 Upper Spacer	12 3rd and 4th Lever Assy.
5 Clutch Rod	13 Spacer Washer
6 1st, 2nd, and Reverse Lever Assy.	14 Clutch Lever
7 1st, 2nd, and Reverse Shift Rod	15 Bulkhead
8 3rd and 4th Shift Rod	16 Rod Clevis

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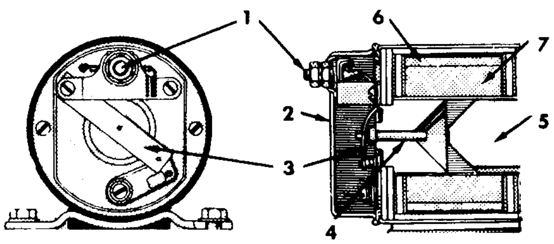
Figure 5—Control Levers at Engine Compartment Bulkhead

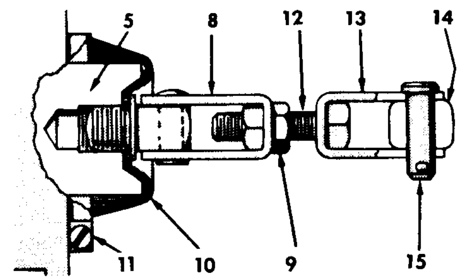
3. Remove nuts and washers from mounting bolts which extend downward from control tower base, and secure the tower to support bracket.
4. Remove support bracket bolts, then remove tower assembly through compartment door.
5. If necessary to disassemble gearshift lever tower, the cap may be removed from top of tower to permit removal of lever, and the four bolts may be removed at bottom of the assembly to permit removal of shift slides and poppets.

INSTALLATION

1. Assemble gearshift lever tower components referring to sectional view in figure 4 for construction. Mounting bolts are installed from upper side of tower and are threaded into base.
2. Install tower assembly through compartment at left front corner of coach. Move assembly into position with gearshift lever and top of tower entered in hole in coach floor.
3. Install mounting bracket bolts, and install nuts and lock washers on tower to bracket bolts.
4. Connect transmission control rods to slides in tower. Secure clevis pins with new cotter pins.
5. Hook clutch pedal return spring to bracket. Check control rod adjustment.



SECTIONAL VIEWS OF REVERSE SOLENOID



SOLENOID LINKAGE

1 Wire Terminal	6 Holding Coil	11 Clamp
2 Cover	7 Pulling Coil	12 Adjusting Bolt
3 Contact Points	8 Link Assembly	13 Clevis
4 Pin	9 Lock Nut	14 Lever
5 Plunger	10 Dust Shield	15 Clevis Pin

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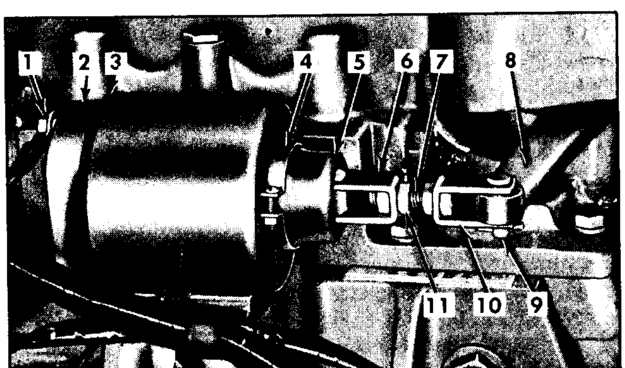
Figure 6—Reverse Solenoid and Linkage Views

REVERSE SOLENOID AND LINKAGE ADJUSTMENT

Whenever the reverse solenoid has been removed or if difficulty is experienced when shifting transmission into reverse speed, the following procedure will properly adjust the solenoid linkage:

1. Be sure transmission control linkage is properly adjusted.
2. Place gearshift lever in 1st speed position.
3. Disconnect wire from terminal and remove cover from solenoid. Inspect contact points. If points are burned or pitted, replace points or dress with a fine cut point file.
4. Try operating lever (8, fig. 7) while observing contact points (3, fig. 6). As lever pushes plunger (5, fig. 6) inward, plunger must contact pin and open points when plunger reaches end of stroke. When current is supplied to solenoid both coils (6 and 7, fig. 6) are energized and cause magnetic pull on plunger; but when points open, the circuit through pulling coil (7) is broken and only the holding coil (6, fig. 6) remains energized. Damage to coils may occur if points do not open at end of plunger stroke.
5. If necessary to make an adjustment, refer to figure 7 and loosen lock nut (11), remove clevis pin (9) and turn clevis (10) while holding link assembly (6). Install clevis pin and tighten lock nut, then recheck action as directed in Step 4 above.
6. Finally, start engine and check operation of the transmission controls.



1 Terminal	7 Bolt
2 Cover	8 Reverse Lever
3 Felt Gasket	9 Clevis Pin
4 Clamp	10 Clevis
5 Dust Shield	11 Lock Nut
6 Link Assembly	

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Figure 7—Reverse Solenoid Installation

LOW OIL PRESSURE SWITCH

To determine if low oil pressure switch (13, fig. 9) is functioning properly, turn on driver's master switch to either "Day" or "Nite" position. With engine stopped, the "TRANS. OIL" tell-tale should be illuminated. When engine is running, the tell-tale should not be illuminated.

If the tell-tale does not illuminate with engine stopped, connect a jumper wire between the switch terminals. If tell-tale does not light with jumper in place, the wiring or tell-tale bulb is defective. Refer to ELECTRICAL SYSTEM (SEC. 7) for required information and replace bulb or make necessary repairs.

If tell-tale does light with jumper wire connected across switch terminals, the switch is defective and must be replaced.

To determine if a switch is functioning properly, connect switch in series with battery and light bulb, and connect switch to a hydraulic pressure port equipped with a gauge and means for varying the pressure.

With no pressure applied, the bulb should light. As pressure rises the bulb should "go out" at 1 to 2 psi.

Replace switch in case of malfunction.

LUBRICATION SYSTEM MAINTENANCE

Oil Filter Element Replacement

Key numbers in text refer to figure 3.

The oil filter assembly is mounted at base by three bolts threaded into transmission bearing cap. The element is disposable type which threads onto a nipple on filter base.

At intervals specified in LUBRICATION (SEC. 13) replace filter element as follows:

1. Use a wrench on the "hex"-shaped lower end of element and turn the element cartridge counterclockwise and remove from base.
2. Wipe filter base with clean cloth and check base mounting bolts to see that they are tight.
3. Oil the mating rubber surface on new filter cartridge gasket, then screw cartridge onto base. Torque to 10-15 foot-pounds. Do not overtighten.
4. Start engine and after running for several minutes check oil level on dipstick. Add oil as required to raise level to "HOT" or "COLD" mark on transmission dip stick depending on temperature of lubricant. Inspect filter for evidence of leakage.

TRANSMISSION OIL PUMP AND LINES

CHECKING PUMP PRESSURE

Fluid pump is gear type, mounted at rear of engine, and driven by coupling from accessory drive gear (fig. 8).

To check pump pressure, remove test plug (7, fig. 3) and connect pressure gauge. Start engine and operate at 2000 rpm. Note gauge reading which should be 20 to 60 psi if oil is cold, or 10 to 20 psi if oil is warm.

If pressure test indicates that pump is not functioning properly, remove, and overhaul or replace pump assembly.

PUMP REMOVAL (Fig. 3)

1. Disconnect suction and discharge lines (5 and 8). If there is oil in reservoir on transmission tie the end of suction line up above oil level to prevent oil from running out while line is disconnected.
2. Remove six bolts and lock washers attaching pump assembly to gear train cover, then remove pump assembly and discard gasket.
3. Remove driven hub, coupling spring, and coupling. If necessary to remove drive hub (18), remove bolt and lock washer which holds drive hub (18) to accessory drive gear.

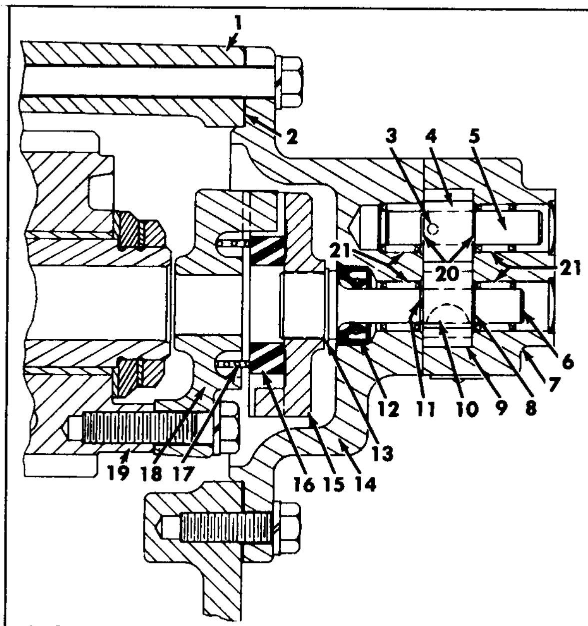
PUMP DISASSEMBLY

Key numbers in text refer to figure 8.

1. Remove eight machine screws which hold two parts of pump body together. Tap with soft hammer to separate the cover (7) from body (14).
2. Remove idler gear and shaft assembly.
3. Remove outer snap ring (8) from drive gear shaft (6), then remove drive gear (9) and key (10). Remove inner snap ring (11) and pull drive gear shaft (6) out of body.
4. If inspection indicates that bearings, gears or oil seal requires replacement, further disassembly is possible. Removal of snap rings (20) and pin (3) permits removal of gear (4) from shaft (5). If bearing assemblies (21) require replacement, they may be removed from cover (7) and body (14) and new bearing assemblies can be pressed into place.

CLEANING AND INSPECTION

1. Clean all pump components thoroughly, using cleaning solvent. Be sure that bearings are clean.
2. Inspect shafts at areas contacted by bear-



1 Gear Train Cover	12 Oil Seal
2 Gasket	13 Snap Ring
3 Gear Pin	14 Pump Body
4 Driven Gear	15 Driven Hub
5 Driven Gear Shaft	16 Coupling
6 Drive Gear Shaft	17 Coupling Spring
7 Pump Body Cover	18 Drive Hub
8 Snap Ring - Outer	19 Accessory Drive Gear
9 Drive Gear	20 Snap Rings
10 Gear Key	21 Bearing Assemblies
11 Snap Ring - Inner	

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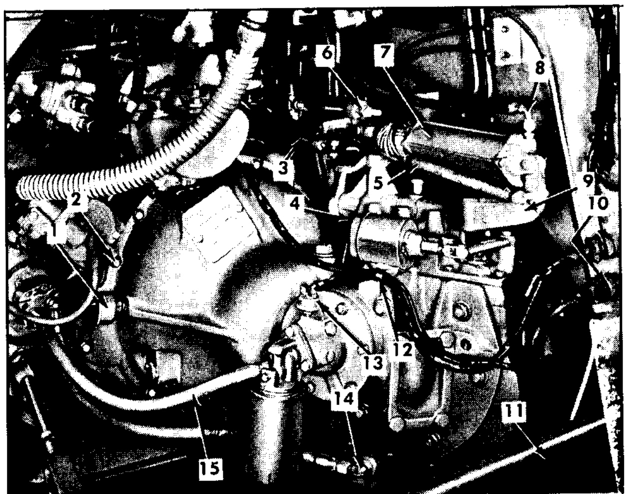
Figure 8—Fluid Pump and Coupling

TRANSMISSION



1 Grease Cup	8 Air Line
2 Flywheel Housing Bolts	9 Air Cylinder Bracket
3 Transmission Shift Rods	10 Wiring Harness Connectors
4 Solenoid Terminal	11 Bumper Extension
5 Clutch Lever Spring	12 Clip
6 Clutch Rod Nuts	13 Oil Pressure Switch
7 Air Cylinder	14 Suction Line
	15 Supply Line

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Figure 9—Transmission Installed (With Early Type Dipstick)

ings and oil seal for evidence of wear.

3. Inspect pump gears for wear, nicks, or other damage that would render these parts unfit for further service.

4. Inspect both halves of pump body for evidence of wear at points contacted by gears.

PUMP ASSEMBLY

Key numbers in text refer to figure 8.

During assembly operations apply engine oil freely to all parts to prevent rusting and provide initial lubrication.

1. Install oil seal (12) with lip toward inner side of body.

2. Press bearing assemblies (21) into place in body and cover.

3. Insert drive gear shaft (6) through oil seal (12) using care to avoid damage to seal. Install inner snap ring (11) and gear key (10) in shaft (6), then install gear and retain with outer snap ring (8).

4. If driven gear (4) has been removed from shaft, install gear and retain with pin (3) and snap rings (20).

5. Set driven gear and shaft assembly in place with short end in bearing in body (14).

6. Apply lead sealer on contact surfaces, then place body cover assembly at body and install eight machine screws. Tighten screws alternately and firmly to seat cover firmly at body.

PUMP INSTALLATION (Fig. 3)

1. Install driven hub on pump shaft splines.

2. Install gasket to pump body.

3. Install coupling spring in drive hub, then install coupling.

4. Position pump assembly to gear train cover, using care that coupling mates with drive hub and driven hub.

5. Secure pump with cap screws and lock washers.

6. Connect suction and discharge lines (5 and 8) at locations shown. If suction line (5) has been removed, clip line at clutch housing ventilation lower cover bolt. Check oil level in transmission, start engine and inspect pump and lines for leaks.

TRANSMISSION REPLACEMENT

REMOVAL

Key numbers in text refer to figure 9.

1. Open engine compartment doors and remove bumper extension (11). Remove dust pans - one below transmission, and one below propeller shaft.

2. Disconnect propeller shaft at transmission yoke. On vehicles with tachograph, disconnect cable housing from threaded sleeve on transmission rear bearing cap.

3. From below engine remove eight clutch housing bolts. Three bolts have tubular spacers.

4. Remove grease cup (1) from clutch housing.

5. Disconnect wiring harnesses from two connectors (10) at bulkhead. Disconnect wires from terminals (4) on reverse solenoid, and oil pressure switch (13). On vehicles with electric speedometer, disconnect wiring from terminal on sending unit.

6. Unhook clutch lever return spring (5) and remove clutch rod nuts (6). Disconnect air line from clutch air cylinder (7), then remove air cylinder and bracket (9). Bracket is bolted to transmission cover.

7. Disconnect shift rods (3) from transmission levers.

8. Remove magnetic plug (9) from reservoir and drain transmission oil in clean receptacle. On late vehicles, remove external dipstick.

9. Remove suction and discharge lines (14 and 15) at fittings on transmission. Line (14) is clipped at ventilation cover bolt which must be removed.

SAFETY CAUTION

Before proceeding with next step, block coach body securely. When attaching hoist to take weight of transmission, the coach body may be inadvertantly raised just enough to cause height control valve to exhaust, in which case entire weight of rear end of coach will be placed on hoist.

10. Attach lifting tool and hoist (fig. 10) to support weight of transmission, then remove nine remaining bolts at clutch housing flange. Move transmission assembly straight away from engine until shaft splines are disengaged from clutch disc hubs, then turn transmission and remove from engine compartment.

INSTALLATION

Key numbers in text refer to figure 9.

NOTE: Whenever transmission is removed, the position of clutch levers should be checked using gauge as directed in CLUTCH (SEC. 5).

1. Assemble clutch release mechanism at clutch housing referring to CLUTCH (SEC. 5) for necessary information.

2. Attach lifting equipment and raise transmission assembly to level of engine assembly (fig. 10). Roll the hoist into position and swing transmission into engine compartment. Guide splined shaft into position in clutch disc hubs. Align clutch housing flange with engine flywheel housing and install nine attaching bolts and washers from clutch housing side. Install eight bolts and washers from flywheel housing side using tubular spacers on three of the bolts at original locations.

3. Connect propeller shaft at yoke on transmission and connect cable housing at threaded sleeve on transmission bearing cap. Refer to PROPELLER SHAFT (SEC. 18) for necessary information regarding universal joint.

4. Connect suction and discharge lines (14 and 15) to threaded fittings at transmission. Line (14) is clipped at ventilation cover bolt at bottom of clutch housing. Check transmission drain plug, which must be tight. Install dipstick and tube on late vehicles.

5. Install grease cup (1) at clutch housing. Install air cylinder bracket (9) on transmission cover. Mount air cylinder (7) using clevis pins at bracket and at clutch lever. Install clutch lever spring (5) and spring extension. Referring to CLUTCH (SEC. 5) install clutch rod nuts and adjust clutch linkage as directed.

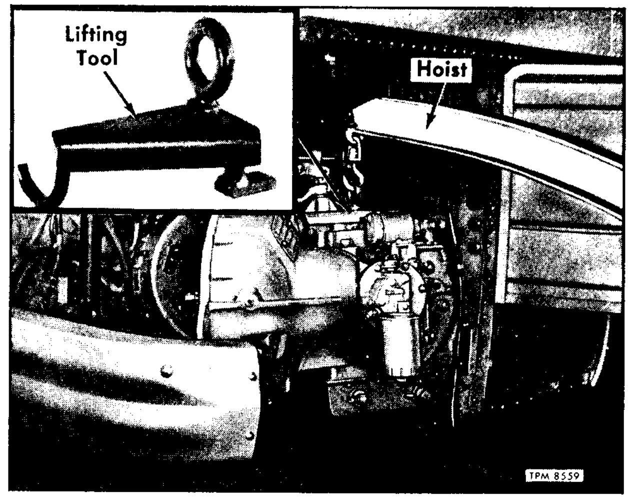


Figure 10—Removing Transmission With Hoist and Lifting Tool

6. Connect transmission shift rods (3) to levers on transmission. Be sure transmission controls are properly adjusted as previously directed under "Maintenance" in this section.

7. Connect electrical wiring harnesses at connectors (10) on bulkhead. Connect wires at reverse solenoid and clip harness at mounting bolt. Connect wires to two terminals on low oil pressure switch (13). Connect wiring at electric speedometer sending unit, on vehicles so equipped.

8. Install bumper extension (11) and the two dust pans - one below transmission and one below the propeller shaft.

9. Fill transmission to level mark on dip stick.

TRANSMISSION OVERHAUL

DISASSEMBLY INTO MAJOR COMPONENTS

REMOVING REVERSE SOLENOID AND TRANSMISSION COVER

Key numbers in text refer to figure 1.

1. Remove bolts which attach reverse solenoid (2) and lever (7). On vehicles with electric speedometer, remove sending unit and drive cable assembly.

2. Remove bolts which attach cover assembly (6) to transmission case, then remove the cover assembly including shift levers and forks.

3. Remove cover gasket.

REMOVING CLUTCH HOUSING AND BEVEL DRIVE GEARS

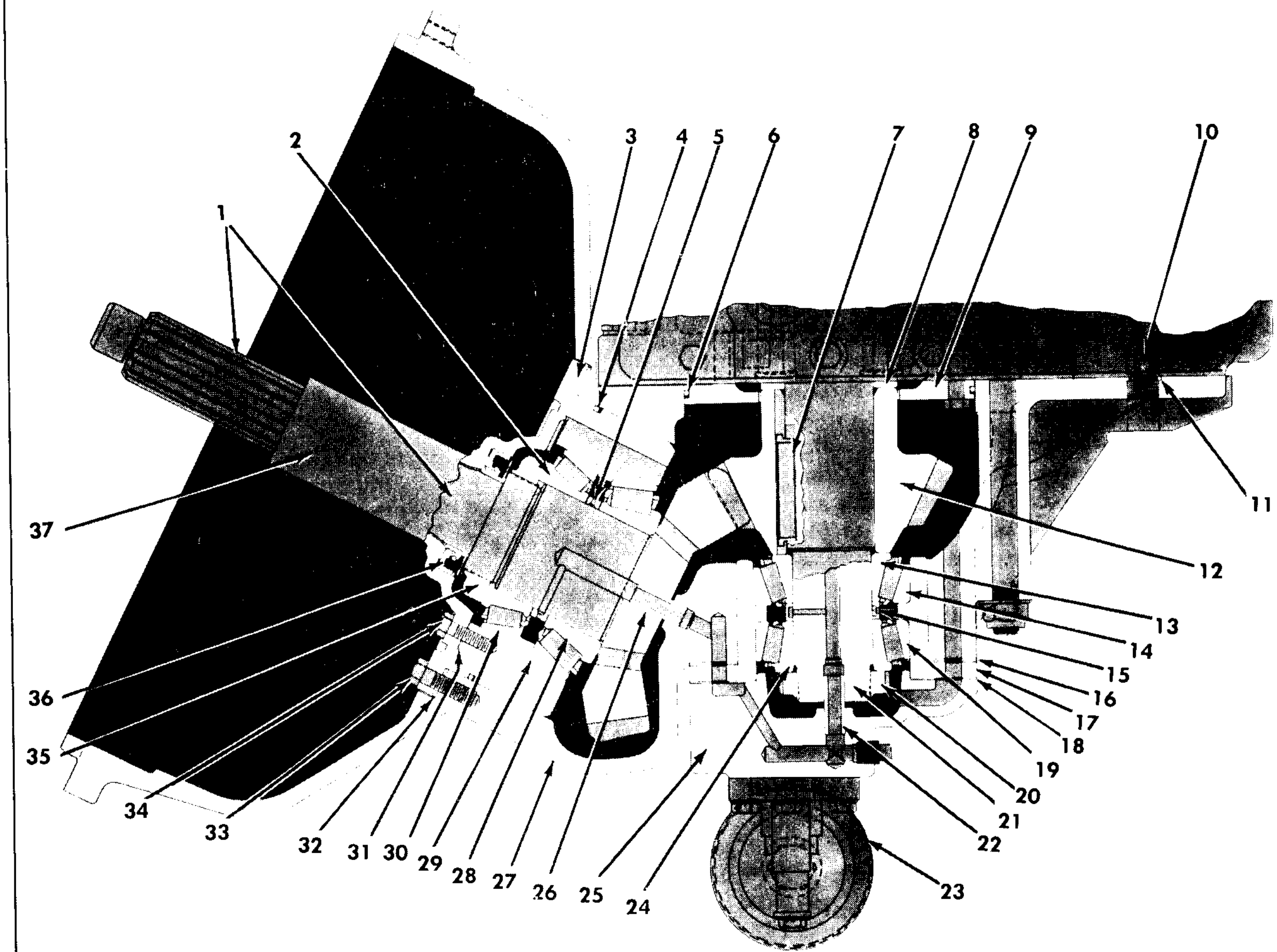
Key numbers in text refer to figure 11 unless otherwise indicated.

1. Remove oil filter assembly (23) from mounting pad on bearing cap assembly (25).

2. Remove stud nuts and washers attaching bearing cap (25). Remove bearing cap assembly and gasket (18).

3. Referring to figure 12 shift the sliding clutches to lock mainshaft so it cannot be turned, then remove bearing retaining nut (20) from drive gear (21).

4. Using puller screws in tapped holes in flange on bearing retainer (17) pull retainer and



1 Drive Pinion
2 Outer Bearing Assembly
3 Bearing Retainer
4 O-Ring Seal
5 Bearing Spacer
6 Retainer Seal
7 Key
8 Gear Spacer
9 Drive Gear Bearing Retainer
10 Dowel Pin
11 Dowel Pin Snap Ring
12 Bevel Drive Gear
13 Inner Bearing Assembly
14 Inner Bearing Cup
15 Bearing Spacer
16 Shims
17 Bearing Retainer
18 Gasket
19 Outer Bearing Cup
20 Bearing Retaining Nut
21 Drive Gear
22 Oil Tube
23 Oil Filter Assembly
24 Outer Bearing Assembly
25 Bearing Cap Assembly
26 Oil Tube
27 Clutch Housing Assembly
28 Inner Bearing Assembly
29 Inner Bearing Cup
30 Outer Bearing Cup
31 Gasket
32 Shims
33 Bearing Retainer Bolt
34 Bearing Cap Bolt
35 Bearing Retaining Nut
36 Oil Seal
37 Bearing Cap

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Figure 11—Cross Section at Bevel Gears

bearing assembly (24) out of clutch housing (27). Remove and tag shims (16) so same shims can be installed at assembly.

5. Remove stud nuts and washers which hold clutch housing in place on transmission case (two of the nuts are at transmission case flange), then with lead hammer, jar clutch housing loose and remove from studs. Remove retainer seal (6) from groove in retainer (9), and remove clutch housing gasket.

6. Remove bearing spacer (15) and any shims which may be present. Tie spacer and shims (if used) together for use at assembly. Remove inner bearing assembly (13).

7. Remove bevel drive gear (12) from drive gear (21), pry key (7) out of slot in shaft, and remove spacer (8).

REMOVING OIL RESERVOIR

1. Remove stud nuts and washers which attach oil reservoir to transmission case. Remove reservoir and gasket.
2. Remove screws which hold screen to reservoir and remove screen.

REMOVING REVERSE IDLER GEAR

1. Remove reverse idler gear shaft lock at rear of transmission case.
2. Use puller in tapped hole in reverse idler gear shaft and pull shaft out of transmission case. Referring to figure 12 remove reverse gears, thrust washers and bearings.

REMOVING MAINSHAFT ASSEMBLY AND DRIVE GEAR

Key numbers in text refer to figure 13.

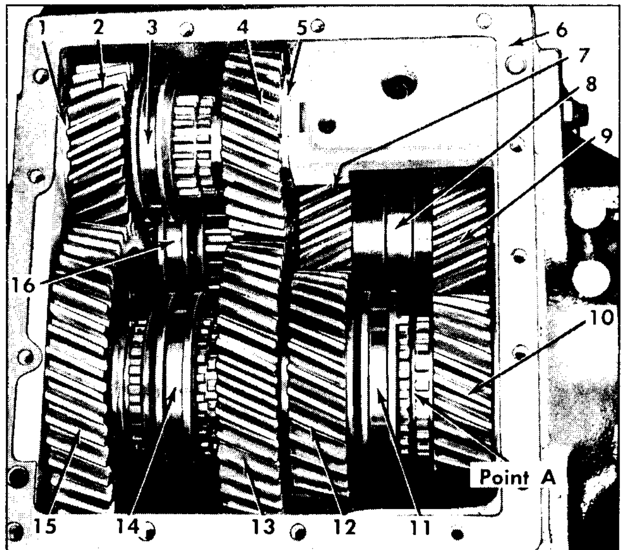
1. With sliding clutches shifted to lock transmission and prevent shafts from turning, remove nut (39) and washer (38) which retain yoke assembly (41) on mainshaft (36). Remove yoke assembly from mainshaft splines.
2. Remove stud nuts and washers which retain rear bearing cap (34), then remove bearing cap and gasket (33). Also remove countershaft bearing cap (53).
3. Remove cotter pin at countershaft nut (77), then remove nut (77). Bend lock (54) away from nuts (45 and 51) at rear end of countershaft. Remove these nuts.

NOTE: The operations described in step 3 are not required in order to remove mainshaft and gears, but should be performed while both shafts are locked to facilitate loosening the countershaft nuts if countershaft is to be removed and disassembled.

4. At front of transmission remove bolts which attach bearing retainer (10), then use two 3/8-16 bolts in puller screw holes in retainer flange to pull retainer (10), bearing (12) and drive gear (15) out of transmission case. Remove mainshaft pilot bearing (14) from mainshaft.
5. Remove speedometer drive gear (31), then remove key (40) from mainshaft.
6. Use two 7/16-14 bolts in puller screw holes in flange on bearing retainer (44), to pull retainer and bearing (43) out of case. Remove retainer and bearing assembly from rear end of mainshaft, then tie mainshaft gears to hold them in place and lift the mainshaft and gear assembly out of transmission case.

REMOVING COUNTERSHAFT ASSEMBLY

1. With nuts (45 and 51) removed from rear end of countershaft (see step 3 in preceding operation) assemble puller to rear bearing retainer (55). Use two 7/16-14 bolts to attach puller to retainer. Tighten puller screw against rear end of countershaft to pull retainer out of case (69) and at the same time remove rear bearing (50) from countershaft.
2. Use arbor press to remove bearing (50) from retainer (55).
3. Remove countershaft 1st speed gear (49) and thrust washer (46) from rear end of countershaft, move countershaft assembly rearward, then raise front end of countershaft and remove the assembly from the transmission case.



1 Rear Thrust Washer	10 Drive Gear
2 Reverse Idler Driven Gear	11 3rd and 4th Speed Sliding Clutch
3 Reverse Idler Sliding Clutch	12 Mainshaft 3rd Speed Gear
4 Reverse Idler Drive Gear	13 Mainshaft 2nd Speed Gear
5 Front Thrust Washer	14 1st and 2nd Speed Sliding Gear
6 Cover Gasket	15 Mainshaft 1st Speed Gear
7 Countershaft 3rd Speed Gear	16 Countershaft Sliding Clutch
8 Gear Spacer	
9 Countershaft Drive Gear	

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Figure 12—Transmission With Cover Removed

DISASSEMBLY OF SUBASSEMBLIES

Key numbers in text refer to figure 13 unless otherwise indicated.

MAINSHAFT DISASSEMBLY

1. Untie gears and remove first speed gear (21) bearings (28) and spacers (29), first and second

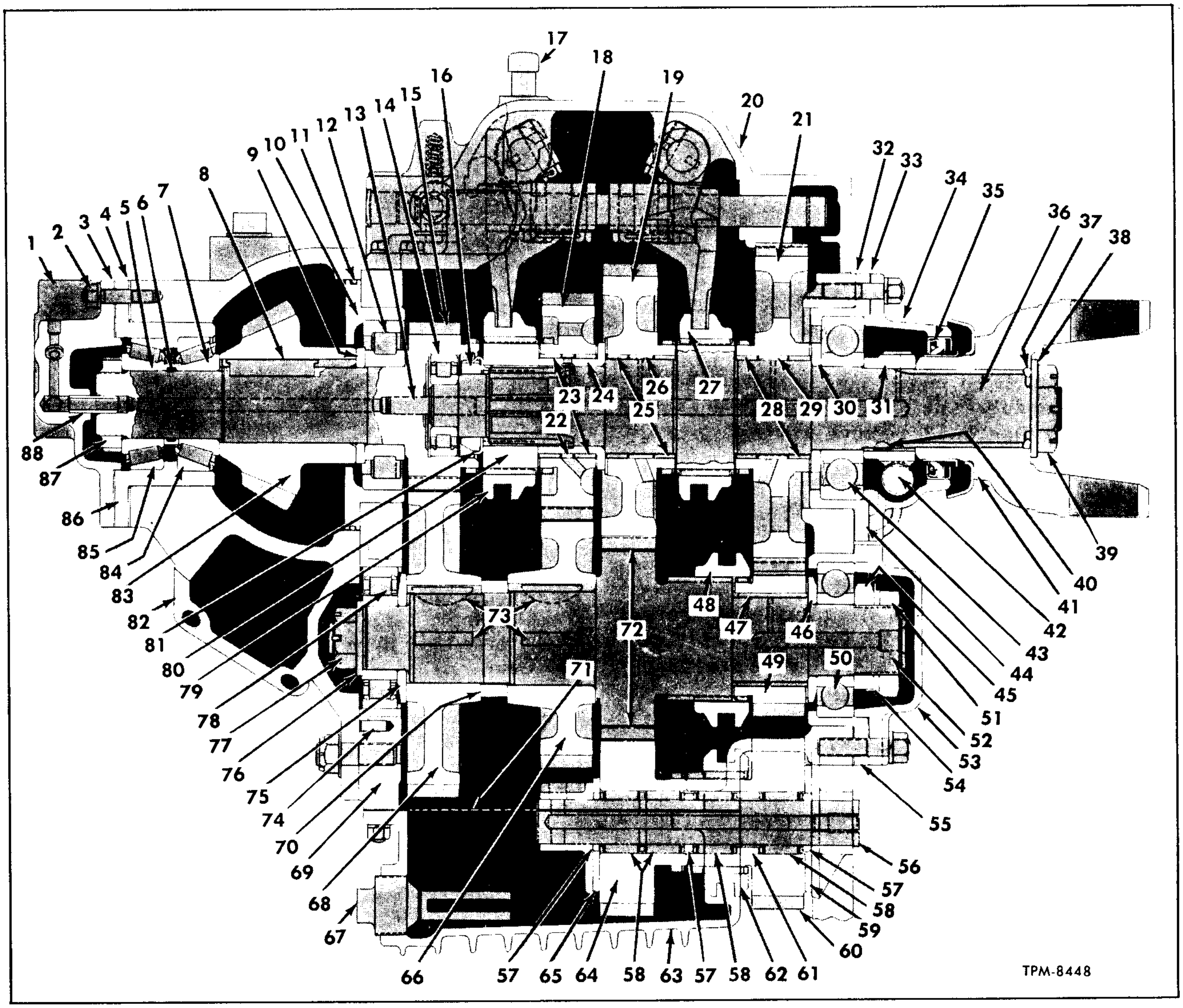


Figure 13—Cross Section of Transmission Assembly

speed sliding clutch (27) and third and fourth speed clutch (79).

2. Raise tangs on lock (81) and remove nut (16) from end of mainshaft (36).

3. Remove clutch gear (80), then remove 3rd speed gear (18), bearings (23) and spacer (22). Remove thrust collar (24) from mainshaft, then remove 2nd speed gear (19), bearings (25) and spacer (26).

COUNTERSHAFT DISASSEMBLY

1. Remove low speed gear sliding clutch (48).

2. With front bearing nut (77) and washer (76) removed, remove front bearing inner race, and retaining washer (75). Bearing and outer race need not be removed unless bearing is to be replaced. In that event, use a suitable tool to remove bearing from retainer in transmission case.

4. Drive gear (68), and gear (66) may be pressed off countershaft separately. Keys (73) at front of countershaft must be removed before spacer (70) and gear (66) can be removed.

BEVEL GEAR AND BEARING DISASSEMBLY

Key numbers in text refer to figure 11 unless otherwise indicated.

1. If clutch release bearing and operating parts are in clutch housing, refer to CLUTCH (SEC. 5) for instructions and remove clutch parts.

2. Remove bearing cap bolts (34), then use two puller screws in tapped holes (11, fig. 2) and remove bearing cap (37). Remove oil seal assembly (36).

3. Remove bearing retainer bolts (33), then using puller screws in tapped holes in retainer

1 Bearing Cap Assembly
2 Stud Nut
3 Gasket
4 Shims
5 Outer Bearing Assembly
6 Bearing Spacer
7 Inner Bearing Assembly
8 Key
9 Gear Spacer
10 Drive Gear Bearing Retainer
11 Retainer Seal
12 Drive Gear Rear Bearing
13 Oil Tube
14 Mainshaft Pilot Bearing
15 Drive Gear
16 Mainshaft Nut
17 Breather
18 3rd Speed Gear
19 2nd Speed Gear
20 Transmission Cover
21 1st Speed Gear
22 Bearing Spacer
23 3rd Speed Gear Bearings
24 3rd and 4th Speed Gear Thrust Collar
25 2nd Speed Gear Bearings
26 Bearing Spacer
27 Sliding Clutch
28 1st Speed Gear Bearings
29 Bearing Spacer
30 Thrust Washer
31 Speedometer Drive Gear
32 Retainer Gasket
33 Cap Gasket
34 Rear Bearing Cap
35 Oil Seal
36 Mainshaft
37 Seal
38 Washer
39 Yoke Nut
40 Key
41 Yoke Assembly
42 Speedometer Driven Gear
43 Mainshaft Rear Bearing
44 Bearing Retainer
45 Inner Lock Nut
46 Thrust Washer
47 Bushing
48 Countershaft Sliding Clutch
49 Countershaft 1st Speed Gear
50 Countershaft Rear Bearing
51 Outer Nut
52 Countershaft
53 Bearing Cap
54 Nut Lock
55 Bearing Retainer
56 Reverse Idler Shaft
57 Bearing Spacer (Short)
58 Roller Bearing Assembly
59 Thrust Washer
60 Reverse Idler Driven Gear
61 Bearing Spacer (Long)
62 Reverse Idler Sliding Clutch
63 Transmission Oil Reservoir
64 Reverse Idler Gear
65 Thrust Washer
66 Countershaft 3rd Speed Gear
67 Drain Plug
68 Countershaft Drive Gear
69 Transmission Case
70 Spacer
71 Screen
72 2nd Speed Gear Teeth (Integral with Countershaft)
73 Gear Keys
74 Dowel Pin
75 Gear Retaining Washer
76 Bearing Retaining Washer
77 Countershaft Nut
78 Countershaft Front Bearing
79 3rd and 4th Speed Sliding Clutch
80 Mainshaft Clutch Gear
81 Lock
82 Clutch Housing
83 Bevel Drive Gear
84 Inner Bearing Cup
85 Outer Bearing Cup
86 Bearing Retainer
87 Bearing Retaining Nut
88 Oil Tube

Captions for Figures 13 and 14

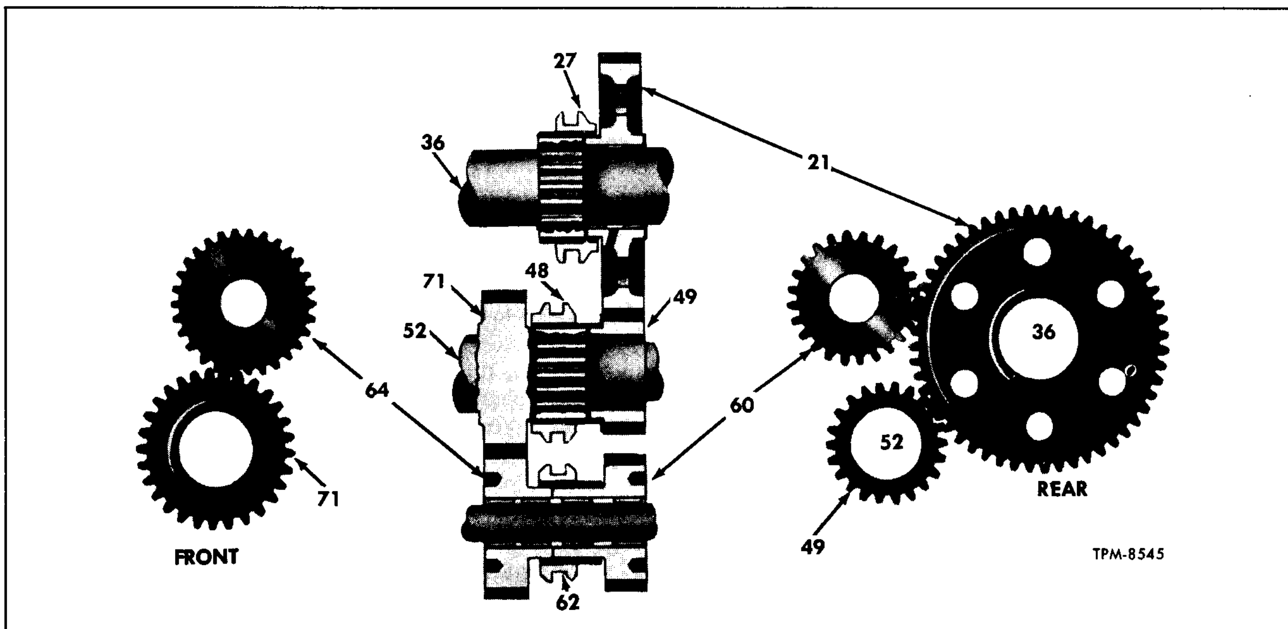


Figure 14—Position of Gears for Reverse Operation

flange, force the bearing retainer (3) out of clutch housing. Drive pinion (1) and bearings will come out with the retainer. Remove O-ring seal (4) from groove in retainer (3). Tag shims (32) so original pack may be used when reassembling.

4. Drive flat wedge under front edge of nut to raise staked portion of nut (35) out of slots in drive pinion (1), then remove bearing retaining nut. Use arbor press and press on front end of drive pinion (1) to remove pinion and inner bearing assembly (28) from retainer (3). Remove outer bearing assembly (2) from retainer and remove bearing spacer (5) and shims (when used) from pinion shaft. Tie spacer and shims together for use when assembling. Use suitable drift through holes in pinion gear to drive inner bearing assembly (28) off pinion shaft, when it is necessary to replace inner bearing assembly. Bearing cups (29 and 30) can be removed from retainer (3) if worn or damaged.

TRANSMISSION COVER AND SHIFT MECHANISM DISASSEMBLY

Key numbers in text refer to figure 15 unless otherwise indicated.

1. Referring to figure 2, remove levers from transmission cover. Outer fingers (3 and 8) are held to respective shafts by clamp bolt and lock washer and are located by Woodruff keys.

2. Move all shift forks to neutral position and remove lock wires used to secure bolts (18).

3. Remove clamp bolts which hold 3rd and 4th shift fork (10) on rod (17). Drive rod (17) forward through fork and force hole plug out of cover. Remove rod (17) sleeve (5) and fork (10). Hold hand over hole in cover boss below poppet and catch poppet ball, plunger and spring as rod is removed from cover.

4. Remove two clamp bolts holding fork (1) on shift rod (16), then drive rod (16) forward out through cover in same manner as described in step 3 above. Use care not to lose poppet parts.

5. Remove two clamp bolts holding reverse shift fork (13) to shift rod (15). Drive rod (15) forward and remove in same manner as previously described for removing rods (16 and 17). Remove threaded plug from side of cover, then remove two shift rod interlocks.

6. At outer side of cover, remove reverse lever collar from shift finger shaft (4). Remove clamp bolt from 1st, 2nd, and reverse inner finger (12), move finger to expose Woodruff key, and remove key. Pull shaft (4) out of cover and remove washer, spring (11) and inner finger (12) from inside cover.

7. Remove clamp bolt from inner finger (7), move finger to expose Woodruff key and remove key. Remove shift finger shaft from cover, and remove inner finger (7) and washer (8) from inside cover. If finger shaft oil seals require replacement, drive old seals out of transmission cover.

CLEANING AND INSPECTION

Clean all parts carefully in suitable cleaning fluid and blow dry with compressed air.

All bearings should be cleaned thoroughly. After bearing assemblies have been soaked in cleaning fluid, tap them sharply on a block of wood to dislodge any solid particles. Slush them again in cleaning fluid and blow dry with air. Do not spin the bearings with the air - revolve them slowly in races with fingers as air is directed at right angles to the balls or rollers. Examine races and bearings for pits and scores, then oil each assembly thoroughly with clean engine oil.

Individual needle bearing rollers which were removed from main shaft gears should be thoroughly washed and inspected. Replace those bearing rollers which show signs of scores or pits. (There are 138 rollers to each gear.)

Examine teeth on all gears carefully for nicks and worn spots. Do not take chances with gears which are appreciably nicked or scored. Small nicks may be carefully removed with a "slipstone" or hone.

Clean interior of main case and covers thoroughly. Remove magnetic drain plug and clean all particles of metal from magnet and remove all dirt from screen. Blow out all oil passages with compressed air.

Inspect faces on shift forks which contact respective sliding clutches. If forks or sliding clutches are worn or scored replace parts as necessary.

ASSEMBLY OF SUBASSEMBLIES

Key numbers in text refer to figure 13 except as otherwise indicated.

COUNTERSHAFT ASSEMBLY (Fig. 13)

1. Press third speed countershaft gear (66) onto shaft with long hub of gear toward front. Make certain that both keys (73) are in position and keyways are free from burrs.

2. Place spacer (70) and keys (73) in position and press drive gear (68) onto shaft with long hub of gear toward rear.

3. Install drive gear retaining washer (75) with recessed edge toward bearing (78).

4. Install front bearing inner race, retaining washer (76) and nut (77). Tighten nut to 300 to 350 foot-pounds and install cotter pin.

5. Install front bearing (78) in case if it has been removed.

6. Install sliding clutch (48) over countershaft clutch gear with long hub toward front. Do not install first speed gear (49) at this time.

MAINSHAFT AND DRIVE GEAR ASSEMBLY (Fig. 13)

1. Place mainshaft (36) in vise with rear end of shaft down (vise should be equipped with "soft" jaws).

2. Make sure second speed gear (19) is clean, especially on inside diameter, then apply a coat of heavy gear oil. Place gear over mainshaft with gear clutch teeth toward rear.

3. Install 69 roller bearings (25) in hub of gear. Install bearing spacer (26) and push bearings and spacer in position. Then install another row of roller bearings.

4. Install third speed gear thrust collar (24) with oil hole indexed with oil hole in shaft. Install third speed gear (18) and bearings (23) in same manner as second speed gear, except that gear clutch teeth are toward front.

5. Install third and fourth speed clutch gear (80) over splines of mainshaft with chamfered end of splines toward rear. Install sliding clutch (79) over gear (80) with extended edge of gear toward rear.

6. Install lock (81) and retaining nut (16) and tighten nut firmly. Bend lock over flat of nut (16). Install pilot bearing (14) on mainshaft pilot.

7. Position mainshaft with rear end upward, then install sliding clutch (27) with extended edge toward rear (upper) end of mainshaft. Place 1st speed gear (21) on mainshaft with clutch teeth toward sliding clutch (27). Install 1st speed gear bearings (28) and bearing spacer (29) in same manner as described previously for installing second and third speed gears (18 and 19).

8. Coat inner face of thrust washer (30) with grease and place in position. Grease will prevent washer from sliding out of place when assembly is lowered into case and in that manner prevent bearings from falling out when shaft is tilted for installation. It is also a good practice to temporarily wire gears (18, 19, and 21) together to hold them in place while installing shaft.

9. Press outer race of bearing (12) into drive gear bearing retainer (10) and press inner race and roller assembly onto drive gear (15). Install gear spacer (9), and drive gear key (8) into slot in shaft.

NOTE: Assembly and adjustment of inner and outer tapered bearings (7 and 5) is accomplished during transmission build-up and is covered later in this section under "Assembly of Transmission."

DRIVE PINION AND BEARINGS ASSEMBLY

Key numbers in text refer to figure 11.

1. Press inner bearing assembly (28) into place on pinion (1).

2. Install cups (29 and 30) in bearing retainer (3) if cups have been removed.

3. If original retainer and bearings are being used, install bearing spacer (5) and shims which were removed at disassembly. If new bearings and/or retainer are being installed, select service spacer (5) (0.395" thick, #2419741) and service shims to provide a total thickness of 0.439 inches. Shims are furnished in following thicknesses: .003", .005", .010", and .020". Set pinion on bench with splines upward and lower the retainer (3) over pinion shaft (1) and into position at inner bearing (28). Position outer bearing (2) at pinion shaft and drive or press bearing into contact with spacer (5).

4. Install bearing retaining nut (35) and tighten to 500 foot-pounds torque; then measure endwise movement of pinion with respect to bearings. Make note of endwise movement and remove bearing nut, outer bearing assembly, spacer and shims.

5. Determine correct shim pack to use as follows:

Add 0.001 inch to the end play noted in step 4 above, then subtract this sum from the 0.439 inch dimension specified in step 3 above. The result is the correct total thickness for shims and spacer to provide proper bearing pre-load.

6. Select the combination of shims and spacer (5) to give total thickness specified above, and reassemble spacer, shims, outer bearing (2), and nut (35). Tighten nut to 500 foot-pounds.

6. Preload on pinion bearings should be 5 to 15 inch-pounds when bearing nut is tightened. Preload may be determined without a special torque measuring devise by using a spring scale on a string wrapped around the stem end of pinion. The force required on string to rotate pinion is from 5.5 to 17 pounds for proper pre-load.

If pull required to rotate pinion is not 5.5 to 17 pounds, the shim pack must be changed as necessary to provide correct pre-load. A change of 0.001 inch in shim pack will change the torque required to rotate pinion shaft by 7 inch-pounds.

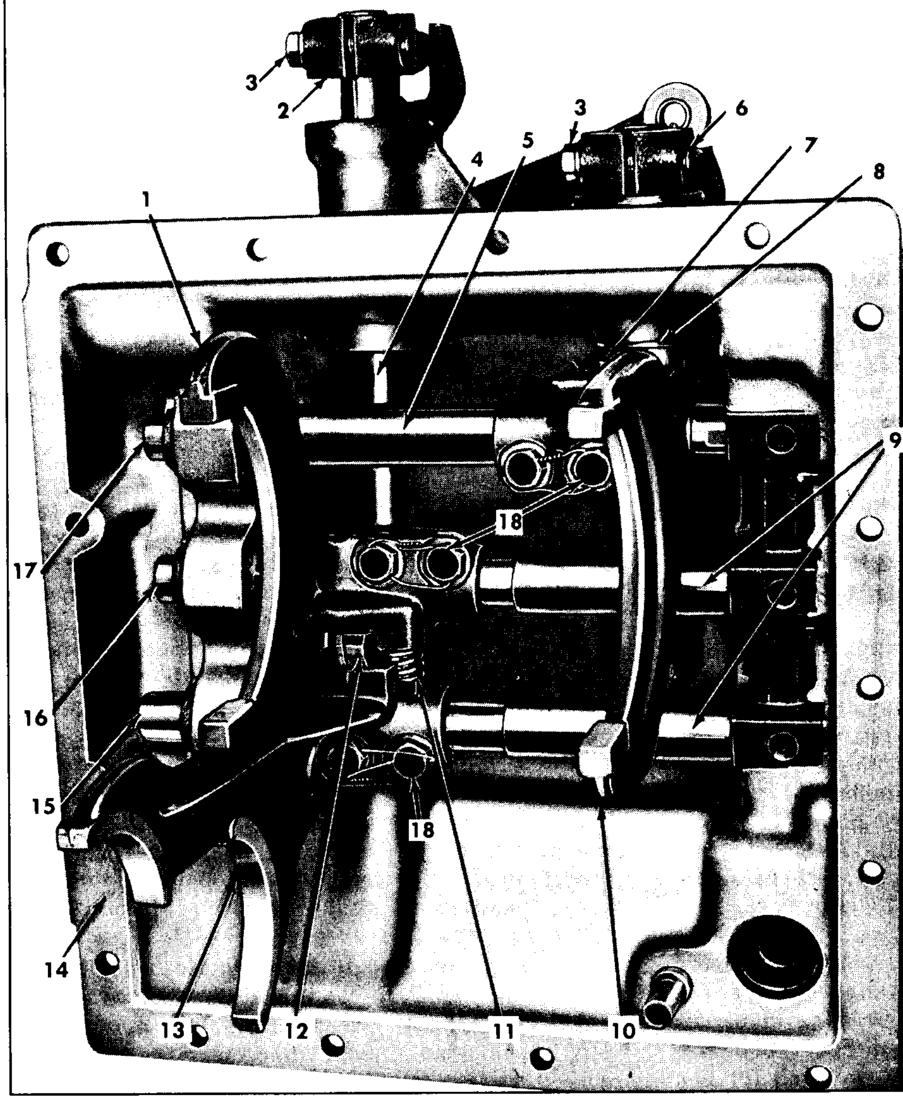
7. When bearing adjustment is completed, stake the bearing retaining nut at slots in pinion to lock the nut.

8. Place new oil seal assembly (36) on pinion shaft with "OIL SIDE" (with oil holes) toward nut (35). Use a sleeve type driver which pilots on pinion shaft and contacts oil seal near inner diameter to seat oil seal solidly at shoulder adjacent to nut (35). Outer casing of seal assembly must be free to rotate without binding after seal is installed.

ASSEMBLING TRANSMISSION COVER COMPONENTS

Key numbers in text refer to figure 15 unless otherwise specified.

1. Install 1st, 2nd, and reverse shift finger shaft (4) in cover, assembling flat washer, spring (11) and inner finger (12) as shaft is installed. Install finger key in shaft, then locate finger so clamp bolt will engage notch in shaft, and install clamp



1 1st and 2nd Shift Fork
2 Shaft Outer Finger
3 Clamp Bolt
4 1st, 2nd and Reverse Shift Finger Shaft
5 Shift Rod Stop Sleeve
6 Outer Finger
7 Inner Finger
8 Shaft Washer
9 Shift Rod Stop Sleeves
10 3rd and 4th Shift Fork
11 Shift Shaft Spring
12 1st, 2nd and Reverse Inner Finger
13 Reverse Shift Fork
14 Cover
15 Reverse Shift Rod
16 1st and 2nd Shift Rod
17 3rd and 4th Shift Rod
18 Fork Bolts

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Figure 15—Transmission Cover With Forks and Shifting Mechanism

bolt in finger (12). Secure clamp bolt with lock wire. If shaft oil seals - one at each side of transmission cover - have been removed, drive new seals into place in cover with seal lips pointing inward. Install outer lever (2) on outer end of shaft (4) using Woodruff key and clamp bolt (3) with lock washer.

2. Install 3rd and 4th shift finger shaft in cover, assembling washer (8) and inner finger (7) on shaft as it is moved into place. Install Woodruff key in slot, locate inner finger (7) on shaft, and install clamp bolt. Secure clamp bolt with lock wire. Install shaft oil seal at outer side of cover if seal has been removed, then install outer finger (6) on outer end of shaft using key and clamp bolt (3) with lock washer.

3. Position cover assembly up-side-down, then drop 3rd and 4th shift rod poppet spring, plunger, and ball through hole in shift rod boss. Hold poppet ball down and insert 3rd and 4th shift rod (17) through hole in front of cover. When end of shift rod is through front support, hold shift fork (10) in cover and push shift rod through fork. Assemble stop sleeve (5) on rod, and move rod into position in cover. Notches in shift rod must be aligned with clamp bolt holes in fork (10) and inner finger (7) must engage notch in shift rod lug. Install two clamp bolts (18), tighten bolts firmly and secure with lock wire.

4. Place one interlock in hole between rods (16 and 17). Install spring, plunger, and poppet ball in center poppet hole, then install 1st and 2nd shift rod (16), stop sleeve (9), and shift fork (1) in position shown in figure 15. Inner finger (12) must

engage notch in lug on fork (1). Install and tighten two fork clamp bolts (18) and secure with lock wire.

5. Place one interlock between rods (15 and 16) and move rods (16 and 17) to neutral position (poppet ball engaging center notch), then install spring, plunger, and poppet ball in poppet hole at reverse shift rod. Install reverse shift rod (15) assembling stop sleeve (9) and shift fork (13) on rod as it is moved into place. Install and tighten two clamp bolts (18) and secure with lock wire.

6. Install three shift rod hole plugs at front of cover and install threaded hole plug at side of cover.

7. Referring to figure 2 install shift levers on transmission cover, with lever yokes engaging outer fingers as shown.

ASSEMBLY OF TRANSMISSION

Apply transmission oil on transmission parts to provide initial lubrication and prevent rusting.

TRANSMISSION MAIN CASE BUILD-UP

Key numbers in text refer to figure 13 unless otherwise indicated.

COUNTERSHAFT INSTALLATION

1. Place countershaft and gear assembly into case, tilt front end upward and lower rear end into case, inserting rear end through rear bearing hole in case far enough to permit front end to be inserted into front bearing (78).

2. Install first speed gear (49) on countershaft by inserting gear through rear bearing hole in case.

3. Install thrust washer (46), recessed edge toward bearing (50).

4. Press rear bearing (50) into retainer (55). Place retainer gasket on studs at transmission case. Be sure retainer dowel pin is in place, then install bearing and retainer, being careful to align notch in retainer with dowel pin in case.

5. Install inner lock nut (45) and tighten to 300 to 350 foot-pounds.

6. Install nut lock (54) and outer nut (51). Tighten nut and lock both nuts by bending lips of washer over flats of nuts.

NOTE: Steps 5, and 6 above may be deferred until after mainshaft has been installed, at which time the gears can be locked to prevent shafts from turning when tightening nuts.

REVERSE IDLER GEAR INSTALLATION

Refer to figure 13 and note position and width of spacers installed, at ends and in between roller bearings. Make sure that oil passages in shaft are clean and that plug in end of shaft is in place. Install reverse idler shaft in following manner:

1. Drive shaft into case just far enough to install thrust washer (59), driven gear, bearings (58) and spacers (57 and 61).

2. As shaft is driven into case, install remaining parts. Front thrust washer fits in notch in case as shown in figure 12.

3. After shaft is driven into case, flat on outer end of shaft must be in vertical position.

4. Install lock plate at rear of transmission case to hold reverse idler shaft in position.

MAINSHAFT AND MAIN DRIVE GEAR INSTALLATION

1. Tilt front end of mainshaft and gears assembly upward and lower rear end into transmission case and out through bearing retainer hole in case.

2. Fit drive gear (15) onto pilot bearing (14) on end of mainshaft assembly, then install retainer (10) and outer race of bearing (12) over end of drive gear and start retainer bolts into transmission case. Do not tighten retainer bolts until mainshaft rear bearing and retainer (44) have been installed.

3. Place retainer gasket (32) on studs in transmission case. Press bearing assembly (43) into retainer (44), and install the bearing and retainer assembly over rear end of mainshaft. Fit rear bearing retainer (44) over studs, and force inner race of bearing (43) into contact with thrust washer (30).

4. Install key (40) in slot in mainshaft, and install speedometer drive gear (31). Check for indexing of oil hole in speedometer gear with oil hole in mainshaft.

5. With oil seal (35) installed in mainshaft rear bearing cap (34) install bearing cap using new gasket (33). Install nuts and lock washers on bearing cap and retainer studs and tighten firmly. Install speedometer driven gear (42) and sleeve.

6. Install yoke assembly (41) on mainshaft splines, install O-ring seal (37) in recess in yoke, then install washer (38) and nut (39).

7. At front of transmission case tighten drive gear bearing retainer bolts, then shift sliding clutches to lock transmission shafts. Tighten yoke nut (39) to 500 to 550 foot-pounds. Install cotter pin to secure nut (39).

NOTE: If countershaft bearing nuts (45 and 51) have not been tightened, tighten inner nut (45), install lock (54). Install and tighten outer nut (51), then bend lock to prevent nuts from loosening. Also tighten countershaft nut (77).

8. Install countershaft rear bearing cap (53) using new bearing cap gasket. Tighten bearing cap and retainer stud nuts firmly.

9. If oil reservoir (63) is removed from transmission, attach screen (71) with three screws, then install reservoir on transmission case using a new gasket.

CLUTCH HOUSING AND ANGLE DRIVE GEAR INSTALLATION

NOTE: If it should be necessary to replace clutch housing or transmission main case, remove two dowel pins (10, fig. 11), then bolt clutch housing to transmission case. Drive gear bearing retainer (9) will serve to properly align housing with case. Drill and line ream dowel pin holes to accommodate oversize dowel pins. Separate the parts and install oversize dowel pins in transmission case. Provide counterbores in clutch housing to accommodate snap rings.

Procedure following includes instructions for installing clutch housing, bevel drive gears, and procedure for setting gears for proper tooth contact.

Key numbers in text refer to figure 11 unless otherwise indicated.

Adjusting Bevel Drive Gear Bearing Pre-Load

1. Install bevel drive gear (12) on drive gear (21).

2. Place O-ring seal (6) in groove in bearing retainer (9) and place clutch housing gasket at transmission case; then install clutch housing on studs and into contact with gasket. Install flat washers and stud nuts on clutch housing-to-transmission studs. Tighten stud nuts evenly and firmly. Stud nuts are self-locking type. Two studs are in clutch housing and nuts are installed at flange on transmission case.

2. Install inner bearing assembly (13), so bearing cone contacts solidly at gear. Place spacer (15) (0.394" thick, #2419742) and a combination of shims to provide total thickness of 0.433 inch on drive gear (21). With inner and outer bearing cups (14 and 19) in place in bearing retainer, assemble retainer to clutch housing using original shims (16) between retainer and housing. Use suitable spacers and nuts on studs to hold retainer firmly to housing.

3. Install outer bearing assembly (24) and nut (20) on drive gear (21) and tighten nut (20) to 300 to 350 foot-pounds torque.

4. Mount dial indicator on retainer stud and check amount of end play in drive gear (21).

5. Shift sliding clutches to neutral and check torque required to rotate drive gear. This can be done with spring scale and string wrapped around nut (20). This rotating torque (without bearing pre-load) must be known in order to compute the amount of pre-load after changing shims as instructed in step 7 following.

6. Remove nut (20), outer bearing assembly (24), and spacer (15) and shims.

7. Determine correct shim pack to use as follows:

Add 0.002 inch to the amount of end play found in step 4. above; then subtract this sum from the 0.433 inch dimension specified in step 2. above. The result is the correct total thickness of spacer and shims to use to produce required bearing pre-load of 5 to 15 inch-pounds.

8. Select the combination of shims and spacer (15) to give total thickness specified above, then reassemble spacer (15) shims, outer bearing assembly (24), and nut (20). Tighten nut to 400 foot-pounds.

9. Determine drive gear bearing pre-load using spring scale and string wrapped around nut (20). Pre-load on bearings will be total pull required above minus the pull required to rotate drive gear (step 5.). This result will be from 3.5 to 11 pounds if bearing pre-load is correct.

NOTE: The bevel pinion (1) should not be assembled to clutch housing while making the foregoing check.

If proper pre-load is not obtained, a change in spacer thickness is necessary. Changing the shim pack 0.001 inch will result in a change of 3 inch-pounds pre-load.

10. Stake bearing retaining nut (20) when proper pre-load is obtained. After bearings are properly adjusted, proceed to install bevel pinion and bearing assembly and set up gears for correct tooth contact and backlash.

INSTALLING BEVEL PINION AND BEARING ASSEMBLY

Key numbers in text refer to figure 11.

1. Install O-ring seal (4) in groove in bearing retainer (3).

2. Locate original shims (32) at flange of retainer (3), then install bevel pinion and bearing assembly in clutch housing and install bearing retainer bolts (33). With transmission in neutral, try turning bevel pinion (1) as bolts (33) are tightened. If any binding is noted it may be due to insufficient backlash between bevel gears (1 and 12). Backlash can be increased by adding shims (32) at retainer flange and backlash must be from 0.006 to 0.012 inch.

3. Check bevel gear backlash with dial indicator. Mount a C-clamp on bevel pinion shaft and mount dial indicator on clutch housing. Set stem of indicator at a point on clamp 2-1/8 inches from surface of pinion shaft. Note on indicator dial the amount shaft can be rotated without moving bevel gear (12).

NOTE: When necessary to change backlash, a change of 0.002 inch in shim pack will change backlash 0.001 inch.

4. Check Gear Tooth Contact. Remove square head filler plug at top of housing above bevel gears. Use a stiff brush and apply a thin even coat of red lead on bevel gear teeth. Rotate bevel pinion shaft in same direction as in normal operation, while applying tension at propeller shaft flange. After

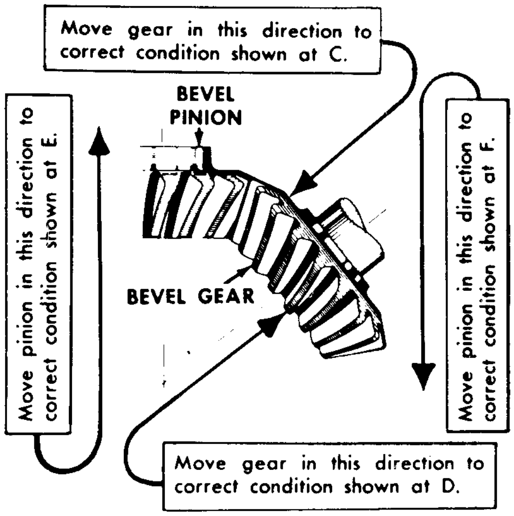
INSTRUCTIONS

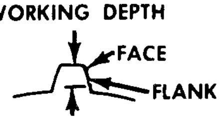
1—Install bevel pinion and bevel gear assemblies; then adjust pinion and bevel gear for proper backlash as directed in "Bevel Gear and Pinion Adjustments" paragraph of this section.

2—Paint three or four teeth of bevel gear with red lead or mechanics blue and rotate bevel gear in direction of rotation until pinion makes complete revolution.

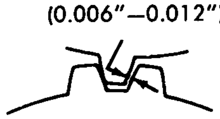
3—Note area of tooth contact which should start at toe and extend about 80 percent of tooth length toward heel, as at B.

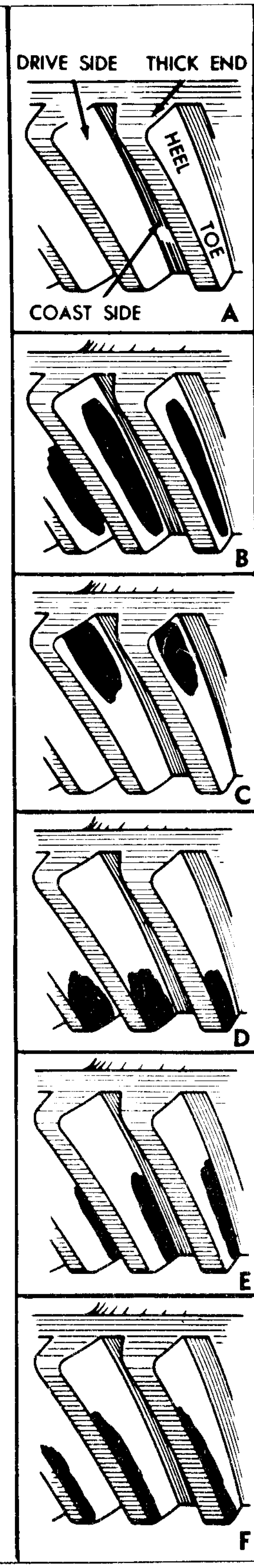
4—Vary position of pinion and gear as per chart until proper tooth contact is obtained. Be sure that sufficient backlash has been allowed so that gear can be completely revolved without any highspots being felt.





BACKLASH
(0.006"—0.012")





A—Check tooth Contact Pattern at drive side of BEVEL GEAR tooth

B—Shows correct tooth contact

NOTE: Key Numbers Below Refer to Figure 11

C—Shows short contact at heel. To correct, increase thickness of shims (16) to move gear toward pinion. Then increase thickness of shims (32) to move pinion away from gear to again secure correct backlash.

D—Shows short contact at toe. To correct, decrease thickness of shims (16) to move gear away from pinion. Then decrease shim thickness (32) to secure correct backlash.

E—Shows heavy contact on flank or lower portion of tooth. To correct, increase thickness of shims (32) to move pinion away from gear until contact comes to full working depth of gear tooth without breaking contact at flank. Then increase thickness of shim (16) to move gear toward pinion to secure correct backlash.

F—Shows heavy contact on face or upper portion of tooth. To correct, decrease thickness of shims (32) to move pinion toward gear until contact covers flank of tooth without breaking contact at face. Then decrease thickness of shims (16) to move gear away from pinion to secure correct backlash.

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Figure 16—Gear Tooth Contact Chart

rotating gears to produce a clear contact impression at drive side of bevel gear teeth (fig. 16), observe contact area through filler plug hole. Use flashlight to illuminate gears.

a. Tooth contact impression should start at toe of tooth and extend back about 80% of tooth length toward heel on drive side of tooth. Contact should be distributed evenly over flank of tooth indicating center of contact below pitch line. Refer to diagrams "A" and "B" in figure 16.

b. If tooth contact is short and too far out on heel of tooth (diagram "C" figure 16), increase thickness of shims (16) between bearing retainer (17) and housing (27), moving gear (12) toward pinion (1). Restore backlash by increasing shims (32) between bearing retainer (3) and housing (27).

CAUTION: When necessary to add shims (16) between retainer (17) and housing, it is important to measure space at point "A" (fig. 12) to determine if drive gear (21) is being pulled too far forward. If space between drive gear and clutch gear (15 and 80, fig. 13) exceeds 0.170 inch, there is danger of rollers in bearing (12, fig. 13) riding against shoulder in bearing outer race. To correct this condition a thicker spacer (9, fig. 13) must be used.

c. If tooth contact extends back from toe appreciably less than 80% of tooth length (diagram "D" fig. 16), move gear (12) away from pinion (1) by decreasing shims (16). Restore backlash by decreasing shims (32).

d. If contact is low on flank of tooth (see diagram "E" fig. 16), move pinion (1) away from gear (12) by increasing shims (32). Restore backlash by increasing shims (16).

e. If contact is high on face of tooth (diagram "F" fig. 16), move pinion (1) toward gear (12) by decreasing shims (32). Restore backlash by decreasing shims (16).

5. After tooth contact and backlash have been adjusted, install bearing cap assembly (25) using new gasket (18). Install oil filter assembly (23) using new gasket.

TRANSMISSION CONTROL COVER INSTALLATION

1. Move the four sliding clutches (3, 11, 4 and 16, fig. 12) to neutral position and locate new cover gasket on transmission case.

2. Shift forks in cover (fig. 15) to neutral position, then carefully lower the cover assembly into place with forks entering grooves in respective sliding clutches.

3. Install cover bolts and lock washers.

4. Mount reverse solenoid and solenoid lever as shown in figure 7, and adjust solenoid linkage as previously directed under "Maintenance."

5. On vehicles with electric type speedometer sending unit, mount sending unit on transmission and connect flexible drive shaft between adapter at transmission rear bearing cap and sending unit.

TRANSMISSION SPECIFICATIONS

SPICER MODEL NUMBER	7145-VC
Speeds	Four Forward - One Reverse
Mounting	On Power Plant Unit
Gear Selection	Manual, Remote Control

GEAR RATIOS

Spicer Model	7145-VC
Angle Drive Gears	.808 to 1
First Speed	3.12 to 1
Second Speed	2.02 to 1
Third Speed	1.21 to 1
Fourth Speed	.808 to 1
Reverse	2.66 to 1

GEAR BACKLASH

Angle Drive Gears	0.006"-0.012"
Mainshaft and Countershaft Gears	0.006"-0.011"
Sliding Clutches and Clutch Gears	0.004"-0.007"

MAINSHAFT GEAR BEARING ROLLERS

Number of rollers per gear	138
Length	0.655"-0.675"
Lapped Diameter	0.12500"-0.12525"

BEARING ADJUSTMENTS

Bevel Drive Gear Tapered Bearing
- See Instructions in Text.

BEARING SPACER THICKNESS (Service)

Bevel Pinion Bearings	0.395"
Drive Gear Bearings	0.394"

BEARING ADJUSTING SHIMS

Sizes Available (Thickness)	0.003", 0.005", 0.010" and 0.020"
Bearing Preload (Rotating Torque)	
Bevel Pinion Bearings	5 to 15 in. lbs.
Bevel Drive Gear Bearings	5 to 15 in. lbs.

BEARING RETAINER SHIMS (for Adjusting Gear tooth contact)

Sizes Available (Thickness)	
Bevel Pinion Gear Bearing Retainer	0.003", 0.005", 0.010", 0.030"
Drive Gear Outer Bearing Retainer	0.003", 0.005", 0.010", 0.030"
Average Thickness of Bearing Retainer Shim Pack	
(at Bevel Pinion)	0.066"
(at Bevel Gear)	0.066"
Necessary Space at Point "A" (Fig. 12) See text.	
Minimum	0.060"
Maximum	0.170"
Thrust Washer Thickness	
Reverse Gear	
Front	0.182"-0.187"
Rear	0.185"-0.187"
Countershaft 1st. Speed Gear	0.245"-0.249"
Mainshaft 1st. Speed Gear	0.262"-0.266"

COUNTERSHAFT 1ST SPEED GEAR BUSHING
Inside Diameter (As Serviced) .... 2.346"-2.349"
Inside Diameter (In Place)
Grind to .... 2.3595"-2.3605"

TRANSMISSION OIL PUMP
Make .... John S. Barnes Corp.
Type .... Positive Displacement (Gears)
Capacity (At Zero psi, 800 rpm) .... 1.10 gal. per min.
Operating Pressure (Max.) .... 50 psi
Gear Length .... 0.6240"-0.6242"
Pump Body Counterbore
Depth .... 0.625"-0.6255"
Diameter .... 1.166"-1.1667"

TRANSMISSION OIL FILTER
Make .... AC
Type .... Full Flow w/By-Pass Valve
Element Type .... Disposable
Number PF-7
By-Pass Valve Opens at .... 4.5 to 5.5 psi

TRANSMISSION OIL LOW PRESSURE SWITCH
Make .... Hobbs Div. of Stewart-Warner Corp.
Circuit Opens at .... 1 to 2 psi
Vendor No. MI-1822

REVERSE SOLENOID
Make .... Delco-Remy Div.
Number 001535
Volts to Operate 12
Current Draw (Amps.)
Both Windings 49.5-56.7
Hold-in Windings 9.53-10.5

1ST AND REVERSE SHIFT MECHANISM
Shift Fork to Sliding Clutch Clearance
Mainshaft Sliding Clutches .... 0.005"-0.016"
Reverse Gear Sliding Clutch .... 0.005"-0.016"
Reverse Shift Shaft Spring
Free Length .... 5/16"
Lbs. Pressure @ 1¾ inch 38-42

TORQUE WRENCH SPECIFICATIONS
(Ft. Lbs.)

Companion Flange Nut 500-550
Mainshaft Nut 300-350
Countershaft Rear Nut 300-350
Countershaft Front Nut 300-350
Drive Gear Outer Bearing Nut 300-350
Bevel Pinion Bearing Nut 500
Bevel Pinion Bearing Cap Bolts 27-32
Bevel Pinion Bearing Retainer Bolts 36-39
Drive Gear Inner Bearing Retainer Bolts 36-39
Shift Lever Studs (In Cover) 240
Stud Nuts
Mainshaft Shaft Rear Bearing Cap 35-43
Countershaft Rear Bearing Cap 53-66
Bevel Drive Gear Bear Cap 27-32
Oil Reservoir 27-32
Clutch Housing 127
Transmission Cover 27-32

Refer to LUBRICATION (SEC. 13)
for recommended lubricants and
intervals of application.

Propeller Shaft

Propeller shaft, used to transmit power from transmission to differential, is tubular type as shown in figure 1. Propeller shaft is equipped with heavy duty needle bearing universal joints. Yoke at slip joint end is splined and is secured to transmission mainshaft with a washer, nut, and cotter pin. A steel dust cap which screws onto slip yoke (fig. 1) prevents entry of dust.

Flange yoke at rear axle is bolted to drive pinion companion flange. Propeller shaft is welded to end yoke at fixed joint end. Slip joint at transmission end of shaft compensates for variation in distance between transmission and differential. These variations are brought about by the rise and fall of the rear axle as the vehicle passes over uneven ground.

LUBRICATION

Universal joint journals are drilled and provided with lubrication fittings, through which lubricant travels to all four oil reservoirs and then, through a hole in side of each reservoir, direct to bearing assemblies. Bearing assemblies are protected against lubricant leakage and the entry of dust by oil seals. Splines of slip joint are lubricated through lubrication fitting installed in slip yoke.

Universal joints and slip yoke splines should be lubricated periodically as specified in LUBRICATION (SEC. 13).

PROPELLER SHAFT AND UNIVERSAL JOINT REMOVAL

Slip yoke and shaft are marked with arrows (fig. 1) to insure correct alignment at assembly. Make sure arrows are clearly discernible before disconnecting slip joint. If arrows are not visible, mark yoke and shaft distinctly.

To remove the propeller shaft from the vehicle when the axle and transmission are in place, proceed as follows:

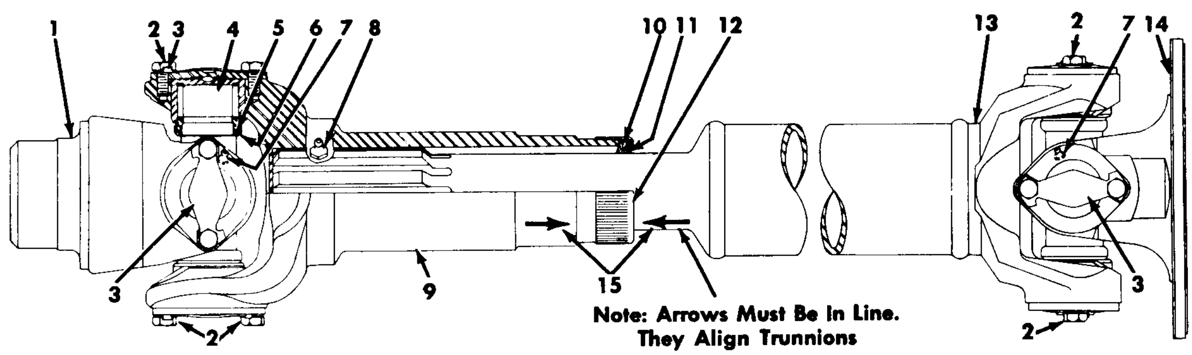
1. Remove nuts and lock washers attaching parking brake drum to drive pinion companion flange, then slide drum back on propeller shaft.

2. Remove lock wire, nuts, lock washers, and bolts attaching propeller shaft flange yoke to drive pinion companion flange (fig. 2).

3. Disconnect slip yoke from transmission splined yoke (fig. 3) by removing two bearings from splined yoke as directed in steps 1 through 3 under "Universal Joint Disassembly."

4. Manipulate propeller shaft as necessary to remove from rear side of bulkhead, removing brake drum from shaft as shaft is removed.

5. To separate slip yoke from shaft, unscrew dust cap from slip yoke and pull yoke off splined stub shaft.



1 Transmission Splined Yoke
2 Cap Screw
3 Lock Strap
4 Bearing Assembly
5 Oil Seal
6 Oil Seal Retainer
7 Journal Lubrication Fitting
8 Slip Yoke Lubrication Fitting
9 Slip Yoke Assembly
10 Washer (Cork)
11 Washer (Steel)
12 Dust Cap
13 End Yoke Assembly
14 Flange Yoke
15 Alignment Arrows

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Figure 1—Propeller Shaft and Universal Joint Installation

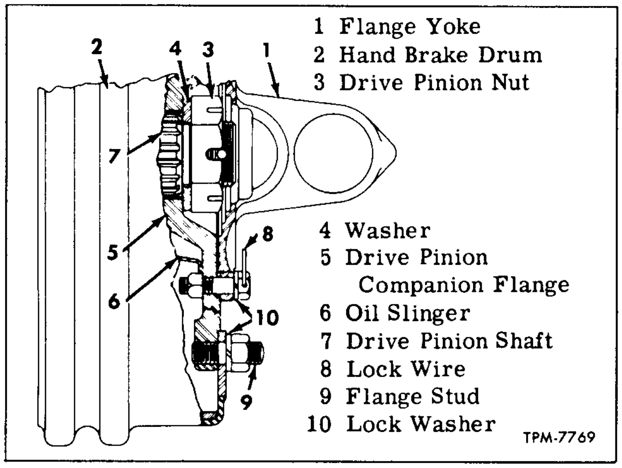


Figure 2—Propeller Shaft Installation At Rear Axle

UNIVERSAL JOINT DISASSEMBLY

(Refer to Figure 1)

The following procedures apply to both the slip and fixed universal joint assemblies.

1. Use a chisel or screwdriver and bend ends of lock straps (3) away from cap screws (2), then remove cap screws and lock straps.
2. Strike one side of yoke with hammer to force one bearing out of yoke; strike opposite side of yoke to force opposite bearing out.
3. Journal can now be tilted to permit removing journal from yoke.
4. Remove the other two bearings in the same manner to permit removing journal from other yoke.
5. Slide oil seals from journal. Remove lubrication fitting from journal. Unless oil seal retainers (6) are to be replaced, do not remove retainers from journals.

CLEANING AND INSPECTION

PROPELLER SHAFT

Use a wire brush and clean all dirt and old lubricant from splines on shaft. Inspect for broken or bent splines. Check shaft for warpage or breaks. If warped or broken, it should be replaced. Welding of broken shafts is not recommended.

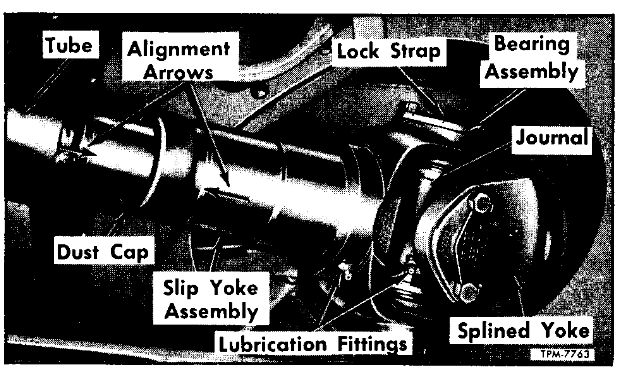


Figure 3—Propeller Shaft Installation At Transmission

SLIP AND FIXED JOINT YOKES

Inspect each yoke for cracks, wear, damage, or bent condition.

Small burrs or rough spots can usually be removed with a hone. See "Specifications" at end of this section for clearance between shaft and yoke splines. Replace worn parts as necessary.

UNIVERSAL JOINTS

Wash all parts with suitable cleaning fluid. Clean all lubricant passages in journals and lubrication fitting. Soak bearing assemblies in cleaner to soften particles of hard grease. Clean bearing assemblies thoroughly, then blow out dirt with compressed air.

IMPORTANT: Be sure that bearing assemblies are clean. Small particles of dirt or grit can cause excessive bearing wear.

Do not attempt to disassemble bearing assemblies. Inspect journal bearing surfaces for roughness or needle bearing grooves. If grooves and roughness will not smooth out with moderate honing, journal and bearing assemblies should be replaced. Check each bearing assembly for wear and missing rollers (see "Specifications" at end of this section). If rollers drop out of bearing, bearing assemblies should be replaced. After bearing assemblies are thoroughly clean, pack with clean grease and turn on journal to check wear.

If excessive clearance is noted, further check of parts is necessary to determine which parts to replace. Inspect oil seal and oil seal retainer and replace if not in good usable condition.

UNIVERSAL JOINT ASSEMBLY

(Refer to Figure 1)

The following procedures apply to both the slip and fixed universal joint assemblies.

1. Install lubrication fitting in journal. If oil seals (5) and oil seal retainers (6) were removed, install oil seal retainers and oil seals on journals.
2. Insert one end of journal into yoke as far as possible from inside and tilt until opposite end of journal clears yoke and drops into position.
3. Insert bearing assemblies (4) from outside of yoke and tap into place with a rawhide or plastic hammer. Do not use steel hammer for this purpose.
4. Joints should move freely in the bearing assemblies and not bind. If joints are too tight, change bearing assemblies around until joints are free and operate smoothly in the assembled position.
5. Install new lock straps (3) and cap screws

(2). Tighten cap screws, then bend ends of lock straps against heads of cap screws.

PROPELLER SHAFT INSTALLATION

1. Install dust cap, steel washer, and cork washer (12, 11, and 10, fig. 1) over splined stub shaft.

2. Lubricate shaft splines with lubricant recommended in LUBRICATION (SEC. 13), then install slip yoke on splined shaft with alignment arrows aligned. Thread dust cap onto slip yoke and tighten hand tight.

3. Insert axle end of propeller shaft assembly through opening bulkhead from rear side, place parking brake drum over shaft, then manipulate shaft into position.

4. Connect shaft at transmission splined yoke by installing two bearing assemblies as previously directed under "Universal Joint Assembly."

5. Position flange yoke at drive pinion companion flange and attach with eight bolts, lock washers, and nuts. Tighten firmly, then thread lock wire through bolt heads and twist ends of wire together.

6. Install parking brake drum over studs on drive pinion companion flange and attach with lock washers and nuts. Tighten nuts firmly.

SPECIFICATIONS

Universal Joint (Slip Joint End)	1701 Series
Universal Joint (Fixed Joint End)	1708 Series
Shaft Diameter	3½"
Journal Bearing Surface Diameter	1.3201"-1.3206"
Bearing Rollers	
Number of Rollers	36
Diameter	⅛"
Length	0.920"-0.925"
Slip Joint	
Yoke Spline Thickness	0.3885"-0.3900"
Shaft Spline Thickness	0.3855"-0.3870"
Clearance—Shaft Splines to Slip Yoke Splines	0.0015"-0.0045"

Propeller shaft must be assembled with alignment arrows matched, otherwise excessive vibration and premature wear will result.

Hubs, Wheels, and Tires

This group includes two sections covering maintenance information on "HUBS AND BEARINGS" and "WHEELS AND TIRES."

Hubs and Bearings

Wheels and hubs are carried on two opposed tapered roller bearings as shown in figures 1 and 2. Bearings are adjustable for wear. Satisfactory operation and long life of bearings depend upon proper adjustment and correct lubrication. If bearing adjustment is too tight, bearings will overheat and wear rapidly. Loose adjustment of bearings will result in pounding and will contribute to steering difficulties, uneven tire wear, and inefficient brakes. Before checking or adjusting wheel bearings, always be sure brakes are fully released and not dragging. Wheel studs are installed in hub flange as shown in figures 1 and 2. Brake drums are mounted over wheel studs on outer side of hub flange and attached to hub with countersunk screws.

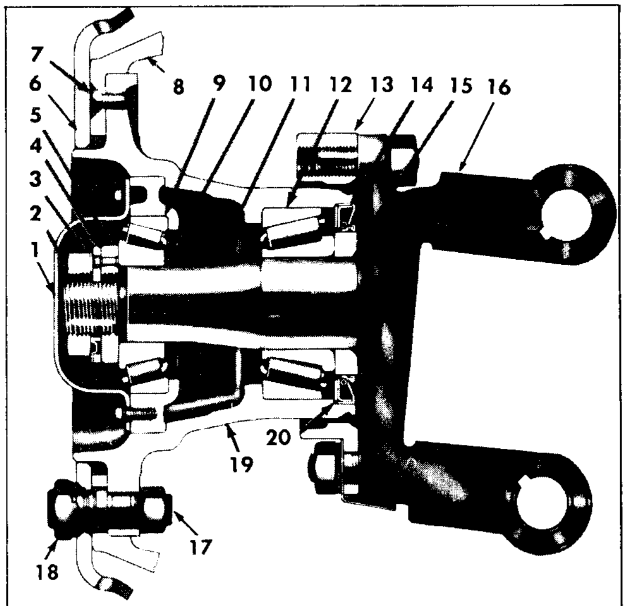
BEARING ADJUSTMENT

Wheel bearing adjustment should be checked carefully at each inspection period. Jack up wheels one at a time and check bearing play by using a pry bar under tires. Observe movement of brake drum in relation to brake spider or brake shoes. If bearings are adjusted correctly, movement of brake drum will be just noticeable and wheel will turn freely with no drag. If test indicates that adjustment of bearings is necessary, make adjustments as follows:

FRONT WHEEL BEARINGS

Key numbers in text refer to figure 1.

1. Remove cap screws and lock washers which attach hub cap (1) to hub (19); then remove hub cap and gasket.
2. Raise lip of nut lock (3) and remove lock nut (2), nut lock (3), and lock ring (4) from steering knuckle spindle (16).
3. Tighten wheel bearing adjusting nut (5) until wheel binds, at the same time turning wheel to make sure all surfaces are in proper contact.
4. Back off bearing adjusting nut (5) 1/6 turn, or more if necessary, making sure wheel turns freely.
5. Position lock ring (4) on steering knuckle spindle, with dowel pin in adjusting nut (5) inserted into hole of lock ring (4). Either side of ring may be turned toward adjusting nut. When installing lock ring, place first one side then the other toward adjusting nut to determine which position will permit dowel pin in nut to line up with hole in ring with least change in position of adjusting nut.
6. Install nut lock (3) and lock nut (2) on steering knuckle spindle. Draw lock nut up tight.
7. Recheck wheel bearing adjustment as described previously; then bend lip of nut lock (3) down against flat of lock nut (2).
8. Position hub cap (1) and new gasket against hub and attach with cap screws and lock washers.



1	Hub Cap	11	Inner Bearing Cone and Roller Assy.
2	Lock Nut	12	Inner Bearing Cup
3	Nut Lock	13	Brake Spider
4	Adjusting Nut Lock Ring	14	Oil Seal
5	Bearing Adjusting Nut	15	Bearing Spacer
6	Wheel	16	Steering Knuckle
7	Brake Drum Retaining Screw	17	Wheel Stud
8	Brake Drum	18	Wheel Nut
9	Outer Bearing Cup	19	Hub
10	Outer Bearing Cone and Roller Assy.	20	Oil Seal Washer

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Figure 1—Front Hub, Bearings, and Oil Seals

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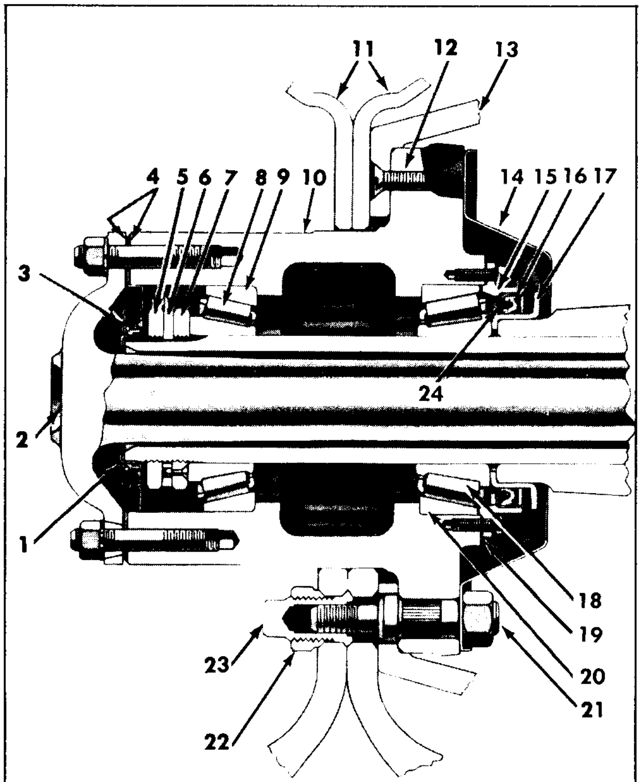

1 Oil Seal Wiper and Cork Assy.
2 Axle Shaft
3 Outer Oil Seal Assy.
4 Gaskets
5 Lock Nut
6 Lock Ring
7 Adjusting Nut
8 Outer Bearing Cone and Roller Assy.
9 Outer Bearing Cup
10 Hub
11 Wheels
12 Brake Drum Retaining Screw
13 Brake Drum
14 Oil Slinger
15 Inner Oil Seal Retainer
16 Inner Oil Seal
17 Inner Oil Seal Wiper
18 Inner Bearing Cone and Roller Assy.
19 Gasket
20 Inner Bearing Cup
21 Wheel Stud
22 Outer Wheel Nut
23 Inner Wheel Nut
24 Oil Seal Washer

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Figure 2—Rear Hub, Bearings, and Oil Seals

REAR WHEEL BEARINGS

Key numbers in text refer to figure 3.

1. Remove axle shaft as directed in REAR AXLE (SEC. 2) of this manual.
2. Remove gaskets (4) and wheel bearing outer oil seal (3) from axle shaft flange studs.
3. Remove wheel bearing outer oil seal wiper and cork assembly (1) from end of axle housing tube.
4. Unscrew lock nut (5) and remove adjusting nut lock ring (6) from axle housing tube.
5. Tighten wheel bearing adjusting nut (7) until wheel binds, at the same time turning wheel to make sure all surfaces are in proper contact.
6. Back off adjusting nut (7) 1/6 turn, or more if necessary, to make sure wheel turns freely.
7. Position lock ring (6), with dowel pin in adjusting nut (7) inserted in hole of lock ring (6). Either side of ring may be used toward adjusting nut. When installing lock ring (6), place first one side then other side of ring toward adjusting nut (7) to determine which position will permit dowel pin in nut to line up with hole in lock ring with least change in position of adjusting nut.
8. Install lock nut (5) and tighten firmly; then recheck bearing adjustment.
9. Press oil seal wiper and cork assembly (1) on end of axle housing tube.
10. Place new inner gasket (40) on hub over axle shaft flange studs.
11. Coat lip of outer oil seal (3) and oil seal wiper (1) with grease; then install oil seal (3) with holes in retainer over axle shaft flange studs. If oil seal is damaged or worn, even slightly, use a new oil seal.
12. Position new outer gasket (4) on hub (10) over axle shaft flange studs.
13. Install axle shaft as directed in REAR AXLE (SEC. 2) of this manual.

OIL SEALS

Front and rear hubs have oil seals at inner end to prevent leakage of wheel bearing lubricant from hubs into brake drums. Inner oil seals also prevent water and dirt from entering hubs and contaminating wheel bearing lubricant. Oil seals at outer ends of rear hubs prevent rear axle differential lubricant from entering hubs and mixing with wheel bearing lubricant.

Inner seals used in both front and rear hubs are rotating, spring-loaded type. Front seals are pressed into inner end of hub and seal lip wipes on bearing spacer (fig. 1). Rear hub inner seals are pressed into seal retainers which are attached to inner end of hubs with screws; seal lip wipes on a wiper sleeve which is pressed on axle housing tube (fig. 2).

Outer seals used in rear hubs are spring-loaded lip-type seals with integral retainers which fit over axle shaft drive flange studs. Lip of oil seal wipes on oil seal wiper which is pressed onto outer end of axle housing tube. Wiper to tube cork gasket is cemented to inner side of wiper.

At regular inspection periods, examine all seals carefully. If there is the slightest indication of wear, deterioration, or damage at sealing surface, a complete new seal assembly should be installed. Examine surface of oil seal wiper, wiper sleeve, and bearing spacer against which oil seals bear. Any nicks, scratches, or rough spots on these surfaces will impair efficiency of seals.

Always spread a thin coating of grease on face of oil seal, oil seal wiper, wiper sleeve, and bearing spacer before installing parts in hub.

FRONT HUB AND BEARING REMOVAL

Key numbers in text refer to figure 1.

1. Raise front end of coach until tires just clear floor.
2. Remove wheel stud nuts and remove wheel and tire.
3. Remove brake drum to front hub retaining screws (7); then remove brake drum (8) from hub (19).
4. Remove cap screws and lock washers attaching hub cap (1) to hub, then remove hub cap and gasket.
5. Raise lip of nut lock (3), then remove lock nut (2), nut lock (3), lock ring (4), and bearing adjusting nut (5) from steering knuckle spindle.
6. Pull hub assembly straight off spindle, being careful not to permit outer bearing (10) to fall out of hub.
7. Remove outer bearing cone and roller assembly (10) from hub.
8. Pull inner bearing oil seal (14) and washer (20) out of hub, then lift inner bearing cone and roller assembly (11) from hub.
9. Perform cleaning and inspection operations outlined under "Cleaning and Inspection" later in this section. If inspection indicates need for replacing inner and outer bearing cups (12 and 9), they may be driven out of hub by using a long brass drift and hammer through opposite end of hub.
10. If necessary to remove bearing spacer (15), drive a chisel between inner edge of spacer and steering knuckle spindle (16) to force spacer out far enough to permit use of a puller. Be extremely careful not to mar or damage steering knuckle spindle with chisel.

REAR HUB AND BEARING REMOVAL

Key numbers in text refer to figure 2.

1. Jack up vehicle as instructed in "WHEELS AND TIRES" section.
2. Remove 10 outer wheel nuts (22) and 10 inner wheel nuts (23), then remove wheels and tires.
3. Remove five brake drum to hub retaining screws (12); then remove brake drum (13) from hub (10).
4. Remove axle shaft (2) as directed in REAR AXLE (SEC. 2) of this manual.
5. Remove wheel bearing outer oil seal (3) and gaskets (4) from axle shaft flange studs.
6. Remove wheel bearing outer oil seal wiper and cork assembly (1) from end of axle housing tube.
7. Remove lock nut (5), lock ring (6), and adjusting nut (7) from axle housing tube.
8. Lift hub (10) off axle housing tube, holding hand over outer end of hub to prevent outer bearing from falling out. Remove outer bearing cone and roller assembly (8) from hub.
9. Remove six screws attaching inner oil seal retainer (15) to hub (10); then remove inner oil seal and retainer (16 and 15) and gasket (19) from hub.
10. If desired, inner oil seal (16) and washer (24) can be pushed out of seal retainer (15).
11. Lift inner bearing cone and roller assembly (18) out of hub.
12. If necessary to remove oil seal wiper sleeve (17), as indicated under "Cleaning and Inspection" following, use chisel or suitable tool and drive sleeve off axle housing. Be careful not to damage axle housing tube.
13. If necessary to remove bearing cups (9 and 20) from hub (10) as indicated under "Cleaning and Inspection" following, they may be driven out of hub by using a hammer and long brass drift through opposite end of hub.

CLEANING AND INSPECTION

CLEANING

1. Immerse bearing cone and roller assemblies in gasoline or other suitable cleaning solvent. Clean bearings with a stiff brush to remove old lubricant. Blow bearings dry with compressed air, directing air stream at right angles to bearing. DO NOT SPIN BEARINGS WITH AIR PRESSURE.
2. Thoroughly clean all old lubricant out of inside of hub and wipe hub dry. Make sure all particles of old gasket are removed from inner end of hub.
3. Clean all lubricant off rear axle housing tube or front axle spindle. Wipe lubricant off oil seals, using a clean cloth dampened with cleaning solvent. Do not permit cleaning solvent or grease to get on brake linings.
4. Wash all small parts such as bearing nuts, lock rings, and oil seal wipers in cleaning solvent. Wipe parts dry.

INSPECTION

1. Inspect bearing rollers for excessive wear, chipped edges, or other damage. Slowly rotate rollers around cone to detect any flat or rough spots on cone or rollers. Do not mistake dirt or grit for roughness. Replace bearing assemblies if any damage is found.
2. Examine bearing cups in hub. If cups are pitted or cracked, they must be replaced with new parts.
3. Carefully examine oil seals for signs of wear, deterioration, distortion, or damage at the

sealing surfaces. Replace oil seal assembly if any of the above conditions are evident.

4. Inspect oil seal wiper, wiper sleeve, or bearing spacer for nicks or rough spots which would cause rapid wear of oil seals. Replace with new parts as necessary.

5. After inspection is completed and parts replaced as necessary, lubricate bearings and inside of hub as directed in LUBRICATION (SEC. 13) of this manual.

FRONT HUB AND BEARING INSTALLATION

Key numbers in text refer to figure 1.

1. If inner bearing spacer (15) was removed, drive into place on steering knuckle spindle. Make sure spacer is fully seated against knuckle flange.

2. If inner and outer bearing cups (12 and 9) were removed from hub, drive or press new cups into hub with wide side of cups toward inside of hub. Make sure cups are fully seated against shoulder in hub and not cocked.

3. Be sure inner and outer wheel bearings (10 and 11) and inside of hub are lubricated as directed in LUBRICATION (SEC. 13) of this manual.

4. Position inner bearing cone and roller assembly (11) inside hub (19).

5. Place oil seal washer (20) in hub; then press oil seal (14) into hub against washer. Lip of oil seal must point toward inside of hub.

6. Coat face of inner oil seal (14) and bearing spacer (15) with grease.

7. Install hub assembly (19) on front axle steering knuckle spindle. Be careful not to damage wheel bearing oil seal assembly (14).

8. Place outer bearing cone and roller assembly (10) on steering knuckle spindle (16) and push bearing into hub with fingers.

9. Install wheel bearing adjusting nut (5) on steering knuckle spindle. Tighten adjusting nut against outer bearing finger-tight.

10. Position brake drum (8) on flange of hub (19) and attach with retaining screws.

11. Place wheel and tire on hub and attach with stud nuts. Refer to "Wheel Maintenance" in "WHEELS AND TIRES" section for wheel nut torque and tightening procedure.

12. Adjust front wheel bearings and complete the installation as previously directed under "Bearing Adjustment" in this section.

REAR HUB AND BEARING INSTALLATION

Key numbers in text refer to figure 2.

1. If inner oil seal wiper (17) was removed from axle housing, reinstall wiper sleeve on housing.

2. If inner and outer bearing cups (9 and 20) were removed from hub (10), drive or press new cups into hub with wide side of cups toward inside of hub. Make sure cups are fully seated against shoulder in hub and not cocked.

3. Lubricate bearings and inside of hub as directed in LUBRICATION (SEC. 13).

4. If inner oil seal (16) was removed from seal retainer (15), install oil seal washer (24) in retainer, then press new oil seal into retainer. Use extreme care when pressing oil seal into place to avoid distorting seal flange.

5. Place inner bearing cone and roller assembly (18) inside hub (10); then position inner oil seal (16) and retainer (15) on inner end of hub (10), using new gasket (19) between retainer and hub.

6. Attach retainer (15) to hub (10) with six screws and lock washers. Tighten screws evenly and firmly.

7. Coat face of oil seal (16) and oil seal wiper (17) with grease.

8. Position hub assembly (10) on axle housing tube, being careful not to damage inner oil seal (16).

9. Place outer bearing cone and roller assembly (8) on axle housing tube. Push bearing into hub with fingers.

10. Install bearing adjusting nut (7) on axle housing tube. Tighten adjusting nut against outer bearing finger-tight.

11. Position brake drum (13) on flange of hub (10) and attach with five retaining screws.

12. Install wheels and tires on hub and attach with wheel stud nuts. Refer to "Wheel Maintenance" in "WHEELS AND TIRES" section for wheel nut torque and tightening procedure.

13. Adjust rear wheel bearings and complete the installation as previously directed under "Bearing Adjustment" in this section.

Wheels and Tires

JACKING UP VEHICLE

Whenever it is necessary to change a wheel and tire on the road, the following procedures must be followed:

FRONT

1. Turn front wheels to extreme right or left, depending on which tire is flat, so that the front of the flat tire is turned outward.
2. Run flat tire up on run-up block. (Run-up block can be made locally to dimensions shown in figure 1.) Fully apply parking brake.
3. Place jack under front axle center as shown in View A, figure 2, and raise vehicle.
4. Remove run-up block and proceed to change tire. Refer to "Wheel Maintenance" later in this section for wheel nut tightening procedure.
5. Lower jack and remove from under axle center.

REAR

Outside Dual

1. To change outside dual, place wooden run-up block (fig. 1) at inside tire.
2. Drive vehicle onto block to raise outside dual off ground. (View B, figure 2, shows inner dual on run-up block with outer dual removed.)
3. Fully apply hand brake, then proceed to change wheel and tire. Refer to "Wheel Maintenance" later in this section for wheel nut tightening procedure.

Inside Dual

1. To change inner dual, fully apply hand brake.
2. Position jack under suspension support as shown in View C, figure 2.
3. Jack up axle and proceed to change wheel and tire. Refer to "Wheel Maintenance" later in this section for wheel nut tightening procedure.

SPARE TIRE AND COMPARTMENT

Spare tire and wheel is stowed in compartment behind front bumper. Small access door in floor of compartment can be opened to check and inflate spare tire without removing tire and wheel from compartment. NOTE: When tire and wheel is stowed in compartment, make sure that tire valve is toward front of coach so that valve is located near small access door in floor of compartment. Accessory tool (special equipment) is stowed in heating compartment.

REMOVAL FROM COMPARTMENT
(When Vehicle is Equipped With Accessory Tool)

1. Open spare tire compartment by inserting wheel wrench through two openings in bumper and unscrew retaining bolts, one each side. Lower front bumper and compartment door.

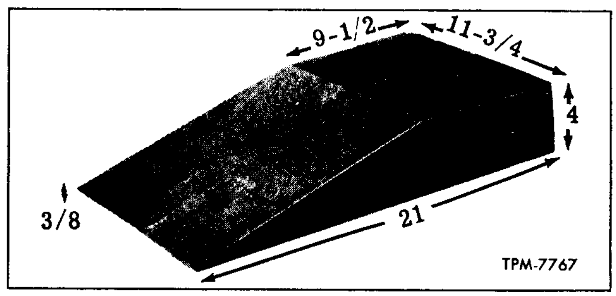


Figure 1—Run-Up Block Dimensions

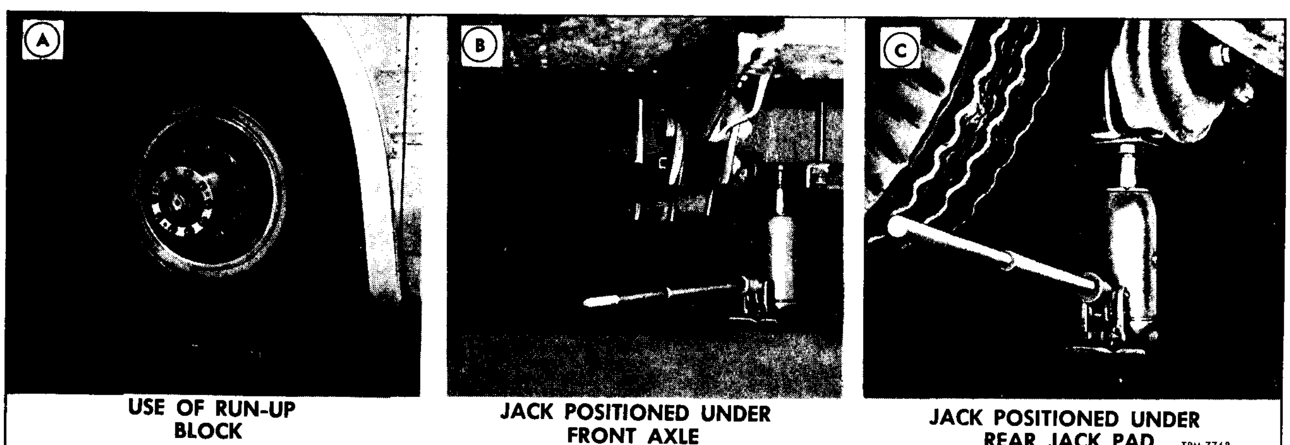


Figure 2—Method of Jacking Up Vehicle

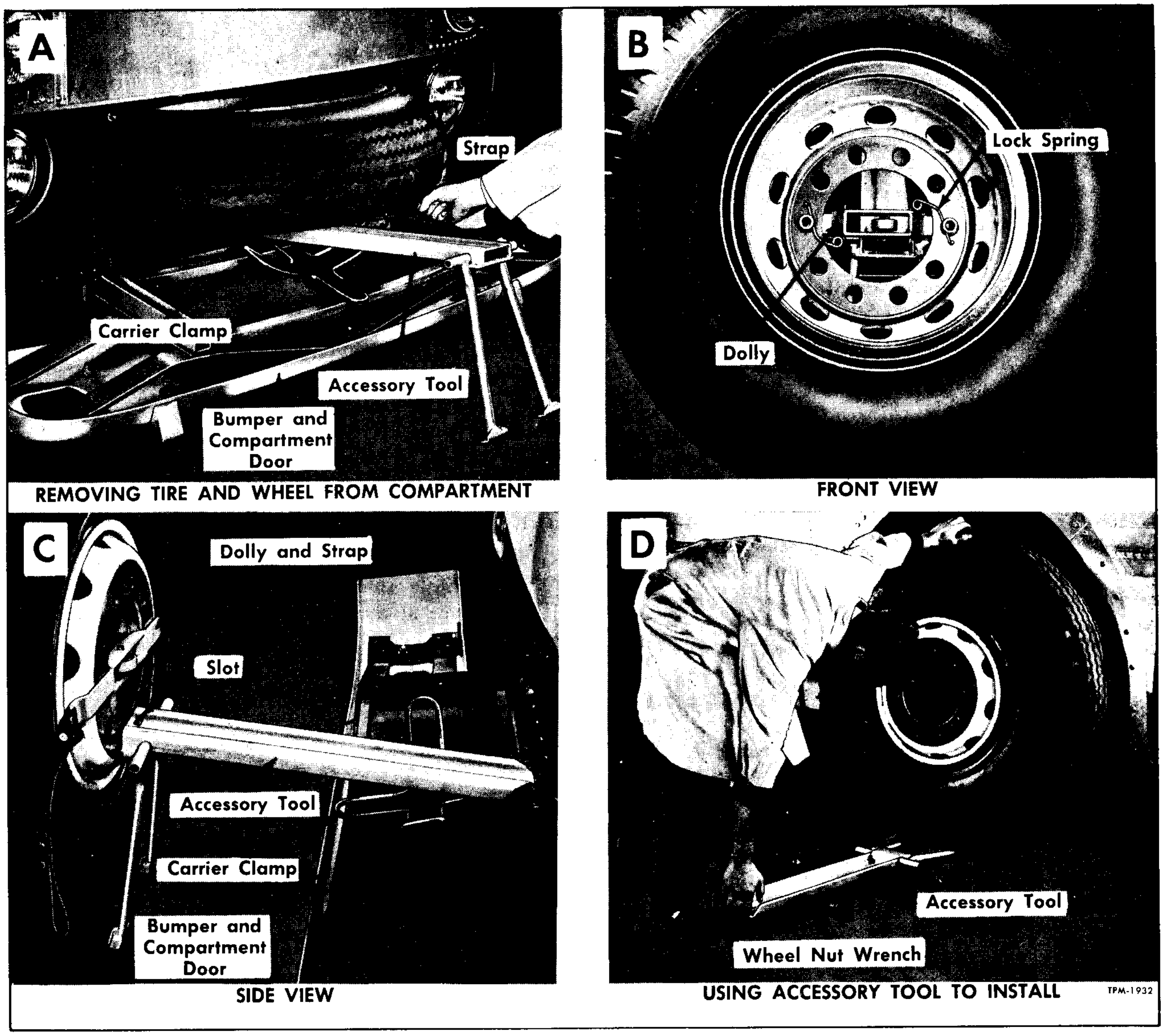


Figure 3—Method of Handling Spare Wheel and Tire (Using Special Accessory Tool)

2. Lower spare tire carrier clamp shown in A, figure 3, then position spare tire accessory tool as shown in C, figure 3.

3. Grasp strap of spare tire dolly (A, figure 3) and pull spare tire with dolly upward and slowly forward until wheel of tire dolly drops into slot in accessory tool (C, fig. 3).

CAUTION: When wheel of dolly approaches slot in accessory tool, use extreme care to prevent wheel from jumping past the slot.

4. Turn tire, wheel, and dolly 1/4 turn and lower tire and wheel to floor as shown in View B, figure 3. Wheel on dolly will engage slot in accessory tool and prevent tire and wheel from slipping off accessory tool and causing injury.

5. Place tire and wheel fully on floor as shown in View C, figure 3, then remove dolly and strap by releasing two lock springs which attach dolly to wheel.

6. Open accessory tool to full length and place wheel nut wrench at lifting end of tool as shown in View D, figure 3, then roll wheel and tire on accessory tool. Lift on end of accessory tool to raise tire and wheel onto hub (View D, figure 3).

INSTALLATION IN COMPARTMENT

1. Position accessory tool as shown in View C, figure 3.

2. Install dolly and strap on wheel by locking two lock springs which attach dolly to wheel as shown in View B, figure 3.

3. Place wheel on accessory tool with dolly in position as shown in View C, figure 3.

4. Turn wheel and tire 1/4 turn so that wheel on dolly will run parallel with accessory tool, then slide wheel, tire, and dolly into compartment as shown in View A, figure 3.

5. Remove accessory tool, then raise tire carrier clamp into proper position. Close front bumper and compartment door and secure with two retaining bolts.

6. Store accessory tool in heating compartment.

WHEEL MAINTENANCE

Wheel studs and nuts on left side of vehicle have left-hand threads. Studs and nuts on right side of vehicle have right-hand threads.

1. Before new vehicle goes into service and after each wheel removal, all wheel stud nuts should be thoroughly tightened. Refer to instructions below for wheel nut torque and wheel nut tightening procedure. See that studs and nuts are free from grease or oil. Do not use oil on studs or nuts.

2. To tighten stud nuts on dual rear wheels, loosen outer nuts, then tighten inner nuts. Tighten opposite nuts alternately so that wheel will be square against hub flange. After tightening inner nuts, tighten outer nuts to specified torque.

3. Re-tighten stud nuts every 100 miles for first 500 miles to offset setting-in of clamping surfaces.

4. Inspect wheel stud nuts at least every 1000 miles thereafter. If vehicle is subjected to severe service, inspection should be made daily regardless of mileage.

5. When changing wheels or tires and before assembling wheels to hubs, remove dirt, grease, and excess paint from the mating surfaces. Dual rear wheels should be positioned with valve stems 180 degrees apart.

NOTE: Cleanliness of wheel and drum mating surfaces is important to proper wheel mounting. On new drums in particular the inner and outer surfaces of the mounting flange should be thoroughly cleaned with solvent to remove the rust preventive coating which is applied for storing and shipping purposes only. This is a wax base substance and should be removed so that solid contact of mating surfaces is obtained.

WHEEL NUT TORQUE

Excessive tightening of wheel stud nuts has proven to be the cause of erratic brake action in some cases. Where excessive torque is applied, brake drum distortion will occur.

Improper procedure in tightening of wheel stud nuts, including excessive torque, has also been found to cause wheel distortion and wheel runout. Such condition will have decided effect on tire life. Wheel nuts should be carefully torqued so that the following limits are not exceeded - 400 to 500 foot-pounds. These specifications have proven to be entirely satisfactory to insure wheel tightness and torque applied exceeding these limits is not recommended. To insure correct torque, a large size torque wrench should be used. A number of torque wrenches suitable to this application are available, one of which is made by "Snap-On" in a 0 to 600 foot-pounds capacity with a 3/4" drive. "Snap-On" tool number is TA 602A, and is also available with a light indicator under tool number TQ 602AL. If a pneumatic impact wrench is used for tightening wheel stud nuts, it should be used only for initial "run-in" of nuts in order to allow wheel to correctly position itself on the hub. Final tightening should be done with a torque wrench to insure that all nuts are torqued evenly and not beyond the limits shown herein.

WHEEL STUD NUT TIGHTENING PROCEDURE

It is important that wheel stud nuts be tightened alternately on opposite sides of wheel. A suggested sequence for tightening is shown in figure 4, and a recommended procedure is as follows:

1. Run the stud nuts in lightly, following the sequence shown, so that wheel will position itself concentrically with hub. THIS IS IMPORTANT; OTHERWISE WHEEL MAY BE ECCENTRIC WITH HUB AND WILL NOT RUN TRUE. In this initial step, run the nuts up only as necessary to correctly position wheel.

2. Tighten nuts progressively in the sequence shown in figure 4 with torque wrench until torque limit is reached. Do not tighten each nut completely at one time, but progress from one nut to another so that wheel is tightened uniformly.

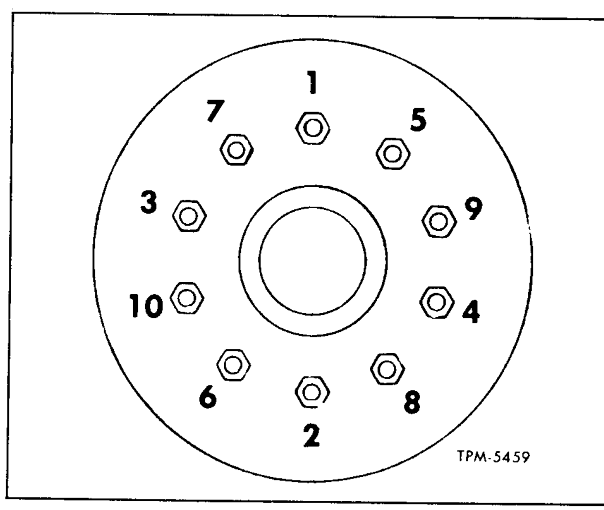


Figure 4—Wheel Nut Tightening Sequence

WHEELS AND TIRES

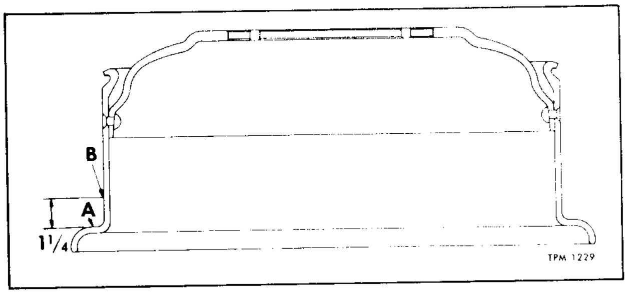


Figure 5—Wheel Checking Diagram

WHEEL INSPECTION

Do not use wheels with bent rims. Continued use of wheels with bent rims will result in excessive tire wear and, if wheel is mounted on front of vehicle, difficulty in steering vehicle will be experienced. Wheels that are thought to be distorted should be checked as follows (see fig. 5):

1. Remove wheel from vehicle and dismount tire.
2. Clean all rust, scale, dirt, and grease from rim.
3. Mount wheel securely in lathe or other suitable fixture. NOTE: Face of hub must run true, as any run-out at that point will be increased from 1-1/2 to 3 times at checking points on rim.
4. Revolve wheel slowly and check at point "A" for lateral run-out (wobble). This should not exceed 3/32-inch. Check at point "B" for radial run-out (out-of-round). This should not exceed 1/8-inch total indicator reading. Wheels that are distorted in excess of these limits should be replaced.

TIRE MAINTENANCE

Coaches are equipped with tube type tires as standard equipment. Tubeless tire wheels and rims are available as special equipment.

One of the most important factors of economical and safe motor vehicle operation is systematic and correct tire maintenance. Tires must not only support weight of loaded vehicle, but they are also integral parts of the transmission and braking systems. Therefore, tires should receive careful, systematic, and regular maintenance as do other operating units. Three major causes of tire trouble are (1) improper inflation, (2) overloading, and (3) misalignment. Tires should be checked periodically for these conditions.

INFLATION OF TIRES

Improper inflation is the greatest cause for loss of tire life expectancy. Tires should be checked frequently for this condition. Tire fabric, rubber bead, contour, and size used on these vehicles are designed to obtain maximum length of service under all operating conditions to which vehicles may be subjected. TIRES ARE DESIGNED TO OPERATE EFFICIENTLY ONLY ON A PRESCRIBED AMOUNT OF AIR. Unless correct air pressure is consistently maintained, tires will not function as they should; consequently safe, economical operation of vehicle will be materially affected.

Operating air pressure recommended by the tire manufacturer is as essential to safe and economical operation of tire, as proper amount of oil would be to an engine or other chassis units.

An under-inflated tire runs sluggishly, heats up quickly because of greater flexing, and is subjected to more frequent bruising.

Over-inflation does not compensate for overloading. It does not add strength to tire, in fact, it actually weakens the tire by reducing its ability to absorb road shock, and may cause a blow-out.

In addition to the deteriorating effect improperly-inflated tires may have on tire life, improperly-inflated tires will effect steering, riding comfort, and safe driving.

Tires are designed to operate at certain recommended inflations, which provide normal flexing with proper deflection and road contact. If flexing is changed from normal, either by over-inflation, under-inflation, or overloading, proper service from tire cannot be obtained. FOLLOW TIRE PRESSURE RECOMMENDATIONS OF THE TIRE MANUFACTURER.

BALANCED INFLATION

The operating efficiency of vehicle will be seriously upset if air pressures in tires are out of balance. Balanced inflation may be expressed as: all tires on the same axle should always carry same air pressure. A difference in air pressure of rear tires and front tires may be permissible within certain limitations; however, there should not be a difference in pressures between right and left tires on the same axle. A five pound under-inflation in one front tire not only can destroy ease of steering, but creates steering hazards which generally point to a potential accident. An under-inflated rear tire can destroy the value of the most efficient brakes. Balance tire pressures for ease of steering, comfort in riding, safety in driving, as well as for minimum fuel consumption and maximum tire mileage.

PRESSURE LOSS

At periodic intervals, each tire should be gauged for pressure loss with an accurate gauge before tires are brought to correct operating pressure. Purpose of this check is to determine exact pressure losses in each tire. In other words, if at the time this check is made, a definite pressure loss is noted in any one of the tires, an inspection

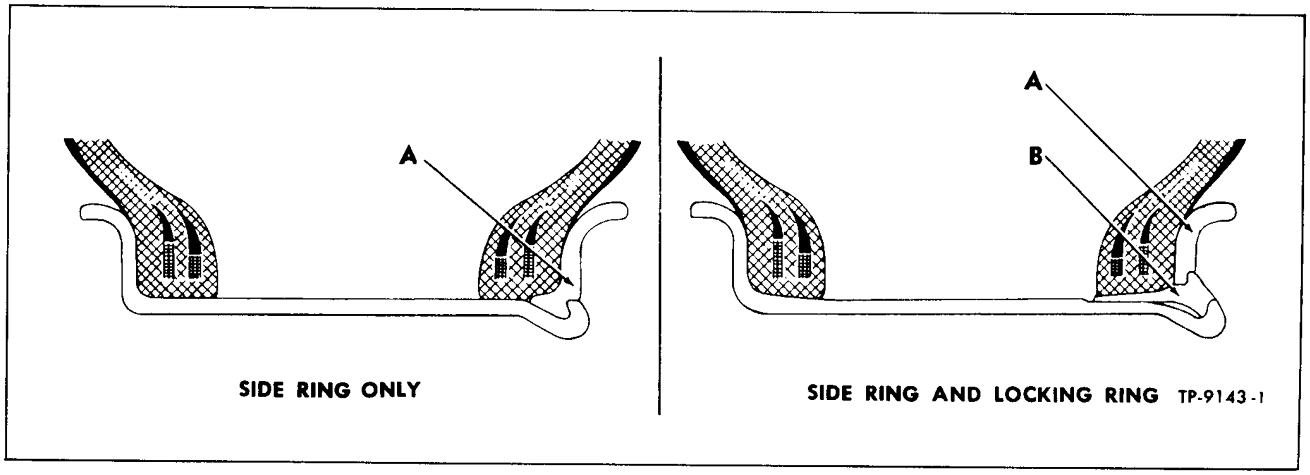


Figure 6—Wheel Rims and Lock Rings (For Tube Type Tires)

should be made of tire showing loss and cause of loss corrected. This method should definitely establish a "danger signal" on the condition of tires. Pressure loss check should be made consistently with the same gauge, so that any element of inaccuracy in gauge will be the same for all tires.

ROTATION OF TIRES

Tires should be interchanged at regular intervals to obtain maximum life. Change wheels without dismounting tires so direction of rotation will be reversed. The following system of interchanging is suggested: Right front to left rear inside or right rear outside. Left front to right rear inside or left rear outside.

If inside dual tires show more wear than outside dual tires, place front tires on inside when changing. In this case, outside dual tires can be interchanged between right- and left-hand side of vehicle.

If outside dual tires show more wear than inside dual tires, place front tires on outside dual tires when changing. At the same time, interchange right- and left-hand inside dual tires.

New tires should be installed on front wheels where they run coolest.

TIRE VALVES

The valve core is a spring-loaded check valve installed in valve stem, permitting inflation or deflation of the tire. This check valve, or core, is not intended to hold the air during operation. The valve cap is provided to seal air in the tube or tire. When valve cap is tightened down on stem, the sealing washer inside cap is pressed tightly against top of stem, preventing air leakage. Valve cap also prevents dirt and moisture from entering valve stem to injure valve core mechanism. It is important therefore, that valve caps be used.

SELECTION OF TIRES

All tires on the same axle should, whenever possible, be of the same make, since differences in design and tread in some instances result in unequal tire rolling radii. It is not possible to match all tires exactly. Therefore, some tolerance must be permitted. When installing tires on a vehicle, all tires on same axle should have the same outside diameter within tolerance limits. The most desirable matching is obtained by not exceeding 3/4-inch difference in circumference or 1/4-inch difference in diameter. If tires do not have the same outside diameter (within 1/4-inch) excessive tread scuffing and hard steering will result. Tire diameters may be measured with a conventional tire measuring gauge.

TIRE REPLACEMENT

Tube type tires are mounted on flat base wheel rims. Inner tire flanges are integral with wheel rims. Tires are secured on wheel rims by continuous type side rings on some vehicles, while other vehicles use a side ring and locking ring (fig. 6). Tubeless tires are mounted on a one-piece drop-center rim that requires no side ring or locking ring. Instructions which follow cover removal and installation of tube type tires only.

REMOVAL
(Tube Type Tires)

WHEELS WITH SIDE RING ONLY

1. Remove valve cap and valve core to completely deflate tube. Replace valve cap on valve stem to prevent entry of dirt into tube.
2. Loosen tire beads from both rim flanges, using suitable hand tools.
3. Lay wheel on floor with side ring up. Insert

tire tool in prying notch of side ring and pry out and up. Use a second tool alongside first tool and pry progressively around ring until side ring is removed from wheel.

4. Force tire valve stem out of slot in wheel and to right or left so it will not catch as tire is removed.

5. Place wheel on blocks, ring side down, and force tire off wheel. Remove flap and tube from tire casing.

WHEELS WITH SIDE RING AND LOCKING RING

1. Remove valve cap and valve core to completely deflate tube. Replace valve cap on valve stem to prevent entry of dirt into tube.

2. Place tapered end of rim tool in depression of locking ring; then press down on side ring to free tire bead.

3. Continue downward pressure on side ring progressively around tire until tire bead is free from seat.

4. To disengage locking ring from wheel gutter, insert rim tool in removing notch of ring and press downward.

5. Insert a second rim tool alongside first tool with tapered end between locking ring and side ring, then press downward to pry ring up. Move progressively around rim until locking ring is free. Lift off locking and side rings.

6. To loosen other tire bead, turn tire over; then drive flat blade tool between bead and rim flange at any point until tool contacts bead seat of rim.

7. Force down on tool handle and insert rim tool; then pull upward to force tire bead away from rim flange. Continue operation until tire bead is completely loosened.

8. Place wheel on blocks, ring side down, and force tire off wheel. Remove flap and tube from tire casing.

INSTALLATION

IMPORTANT: Most "rim accidents" are caused by carelessness and thoughtlessness when inflating tires after mounting. Such accidents are always serious and sometimes fatal. Be on the safe side - ALWAYS FOLLOW PRECAUTIONS DESCRIBED IN THE FOLLOWING:

On all wheels, the lock ring must be fully seated in rim gutter before inflating tire. This is important for the safety of person inflating tire.

As an added precaution, use a steel bar 1-inch in diameter and long enough to extend several inches over lock ring at both ends. Bend bar so it can be inserted through wheel spoke openings with both ends of bar extending over lock ring. Leave bar in place until tire is fully inflated. Examine lock ring to see that it is fully seated, then remove safety bar.

WHEELS WITH SIDE RING ONLY

1. Examine inside of tire and remove all dirt on other foreign particles. Make sure surface of wheel is free from rust or dirt.

2. Install tube in tire and inflate just enough to hold it in place in tire; then install flap.

3. Place wheel on block with ring side up; then position assembled tire and tube on wheel with valve stem in slot.

4. Place side of side ring opposite prying notch in wheel rim gutter. Hold other side of ring down with pry tool in notch; then drive side ring into position with rim mallet.

5. Partially inflate tire; then check to make sure side ring is fully seated. Make sure tire beads are properly seated against rim flanges.

6. Inflate tire to correct pressure; then deflate tire to remove wrinkles from tube. Reinflate tire to recommended pressure and install valve cap.

WHEELS WITH SIDE RING AND LOCKING RING

1. Accomplish steps 1, 2, and 3 under "Wheels With Side Ring Only" preceding.

2. Position side ring "A" (fig. 6) on tire bead. Side ring will be automatically centered when locking ring "B" (fig. 6) is in place.

3. Install lock ring by inserting tapered toe of ring between side ring and bottom of tire bead. Hold locking ring with foot at one end of split; then hammer ring into place with rim mallet.

4. Continue hammering progressively around side ring until entire ring is properly seated in rim gutter.

5. Partially inflate tire; then inspect to make sure side ring is fully seated. Make sure tire beads are properly seated against rim flanges.

6. Inflate tire to correct pressure; then deflate tire to remove wrinkles from tube. Reinflate tire to recommended pressure and install valve cap.

WHEEL NUT TORQUE SPECIFICATIONS

Front Wheel Nuts and Rear Wheel
Inner and Outer Nuts . . . . 450-500 ft.-lbs.

Air Conditioning

This group, covering operation, maintenance, and repair information on GM Air Conditioning is divided into eight major sections as shown in index below:

Information pertaining to a specific control, service, or test, will be found by using quick page reference index shown at beginning of each respective section.

NOTE: Air conditioning controls and units, such as temperature control Grad-U-Stat (thermostat), underfloor blower, heater core unit, and air filter screen are also used in conjunction with the coach heating system. These controls and units which are common to both systems are covered in "HEATING AND VENTILATION" (SEC. 3) in this manual.

General Description

The GM coach air conditioning is designed to provide passenger comfort by cooling, dehumidifying, and filtering the air which is force-circulated within the coach.

The air conditioning system is entirely independent of the coach heating system; however, the entire heating system is utilized to control or temper the air which is cooled by air conditioning. This tempering or temperature-raising process provides the necessary "reheat" phase of air conditioning system.

The air conditioning system units are accessible in coach through access doors at left side of coach. System units are shown schematically in coach as shown in figure 1.

Briefly, the air conditioning system is comprised of the following system and controls. Refer to figure 1.

THE CONDENSING SYSTEM

The condensing system consists of:

1. A Three-Cylinder Reciprocating-Type Refrigerant Compressor, shaft-driven from accessory drive take-off of coach engine. Compressor is mounted below floor, forward of engine bulkhead at left side of coach.

2. A Fin and Tube-Type Condenser Coil with a six-blade type cooling fan. Condenser and fan are mounted in compartment at left side of coach. Fan blade is hydraulically driven from a fluid pump which is mounted to, and belt-driven from refrigerant compressor.

3. A Liquid Refrigerant Receiver which is mounted within the condenser compartment.

THE COOLING UNITS

The cooling units consist of:

1. An Evaporator Coil of fin and tube-type construction mounted in underfloor heating and cooling compartment. Coil is accessible through forward compartment door at right side of coach. Inner closure doors enclose coil.

2. A Refrigerant Expansion Valve of multi-outlet-type mounted to evaporator coil and refrigerant liquid line. Expansion valve is also accessible through compartment at right side of coach.

3. A Refrigerant Heat Exchanger of dual chamber tube unit is mounted into both high pressure liquid line and low pressure gas line. Heat exchanger is accessible after opening forward closure door in the heating and A/C compartment.

4. A Dehydrator-Strainer of disposable-type is mounted in high pressure liquid line at rear of the condenser compartment.

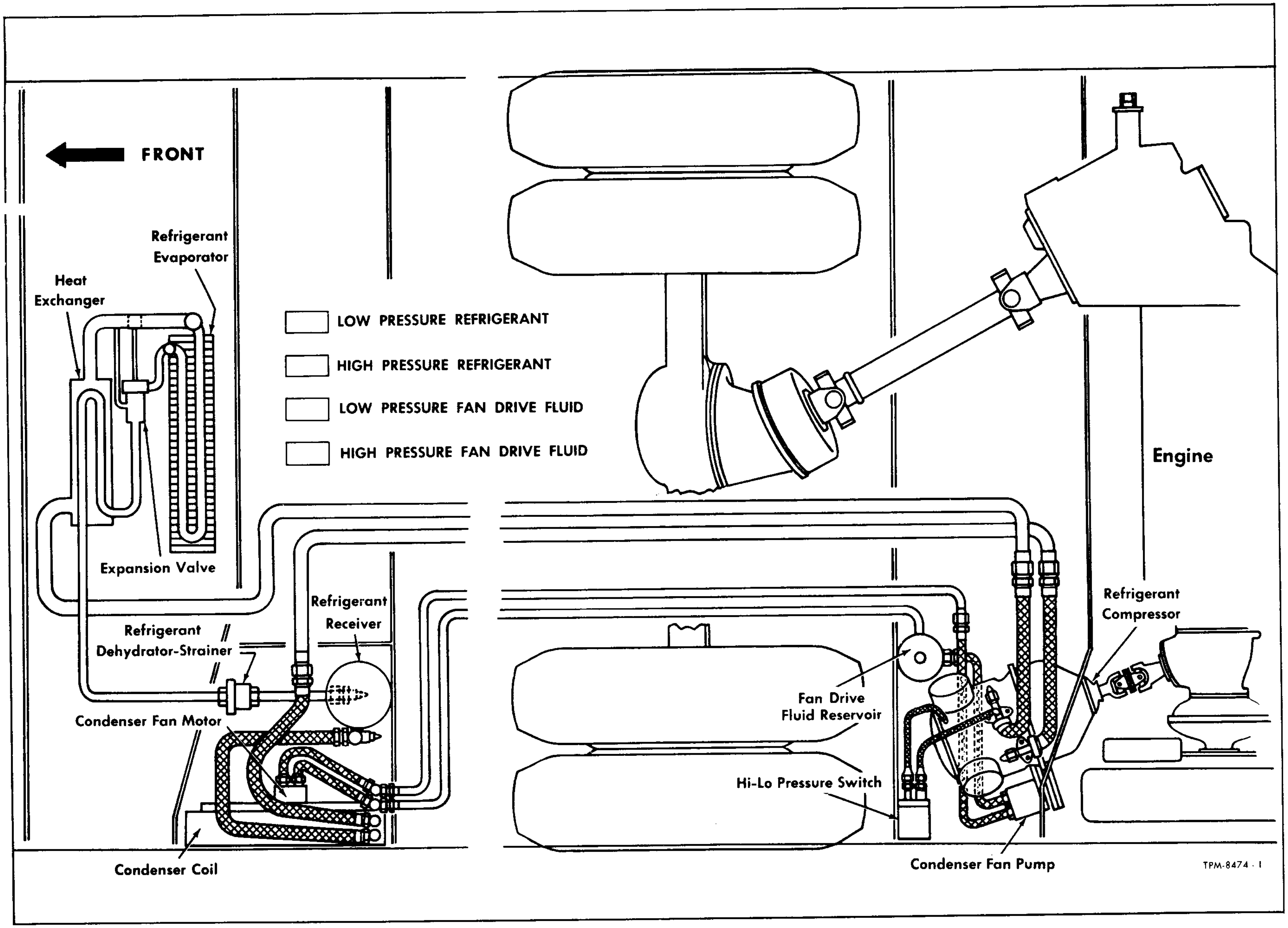


Figure 1—Schematic of Refrigerant Lines and Condenser Fan Drive Fluid Lines

THE AIR CIRCULATION SYSTEM

The air circulating system consists of same air intakes, filters, blowers, and air distribution ducts which are employed for coach heating.

SYSTEM CONTROL UNITS

The air conditioning system controls consist of "VENTILATION" switch on panel at left of driver, an electrically-energized air-operated friction clutch mounted to drive end of refrigerant compressor, and several automatic controls such as pressure switches, relay and air supply solenoid valve which are described later under "System Operation."

DRIVER'S OPERATING INSTRUCTIONS

Driver's control of air conditioning is accomplished by the positioning of switch marked "VENTILATION" mounted on control panel at left of driver. Switch positions are marked "AIR CONDITION," "BLOWER - LOW - HI" and "OFF."

TO OPERATE COOLING SYSTEM

With engine running at low rpm, rotate switch knob to "AIR CONDITION" position. With switch in this position, the underfloor blower high speed circuit is energized and blower runs continuously at high speed. Except for this action operation of the air conditioning system is completely automatic.

On some coaches, the temperature thermostat setting can be regulated within a range from 68°F. to 78°F., by use of dial control marked "TEMP. RANGE" at rear of driver's control panel.

A short delay may occur before air conditioning system starts to operate. Two likely reasons for this condition are:

1. Engine oil pressure too high at normal idle: Engine oil pressure switch contacts will not close to complete circuit to air conditioning controls if oil pressure exceeds 15 psi. Engagement will occur as soon as oil warms up and pressure drops below 15 psi.

2. Pressure in coach air system is low: A minimum of 65 psi air pressure is required to operate compressor clutch controls. Build up required air pressure.

NOTE: When operating system for any extended period of time while the vehicle is parked, the engine rpm should be increased to fast idle by applying the parking brake, then placing "FAST IDLE" switch on control panel at left of driver in "FAST IDLE" position.

NOTE

The "A/C STOP" tell-tale located at top of gauge and tell-tale panel in front of driver will illuminate whenever the refrigerant "HI-LO" pressure switch contacts are open and compressor clutch is disengaged. If light stays on and coach temperature rises, report condition to service personnel.

IMPORTANT: KEEP WINDOWS AND OUTSIDE AIR FRONT INTAKES CLOSED AND DO NOT LEAVE ENTRANCE DOOR OPEN ANY LONGER THAN NECESSARY.

TO OPERATE HEATING SYSTEM

"VENTILATION" switch on vehicles having air conditioning need not be positioned to "BLOWER - HI" or "LOW" for heating system to operate, as underfloor blower will run at low speed whenever the Grad-U-Stat (thermostat) calls for heat. However, on these vehicles the switch can be positioned to "BLOWER - HI" or "LOW" as desired to provide ventilation regardless of the demands of Grad-U-Stat or thermostat.

IMPORTANT

Excessive use of defroster heater at front end may cause high temperature in front of coach, thereby satisfying the thermostat control and leaving the rear area in the coach cold.

System Operation

CONTENTS OF THIS SECTION

GENERAL OPERATION

Some controls and units used with the air conditioning system are common to the coach heating system. These controls and units are: "VENTILATION" control switch, marked "AIR CONDITION," "BLOWER - LOW-HI," and "OFF," air filter screen, heater core unit, air intake and distribution ducts, and the Grad-U-Stat (or thermostat).

The heating and cooling systems operate independently of each other, except under certain conditions of cooling system operation when there is an overlapping operation of both systems as explained previously.

On some coaches the driver can select temperature setting within a 10 degree range by using a "TEMP. RANGE" control on control panel.

When the "VENTILATION" switch on panel at

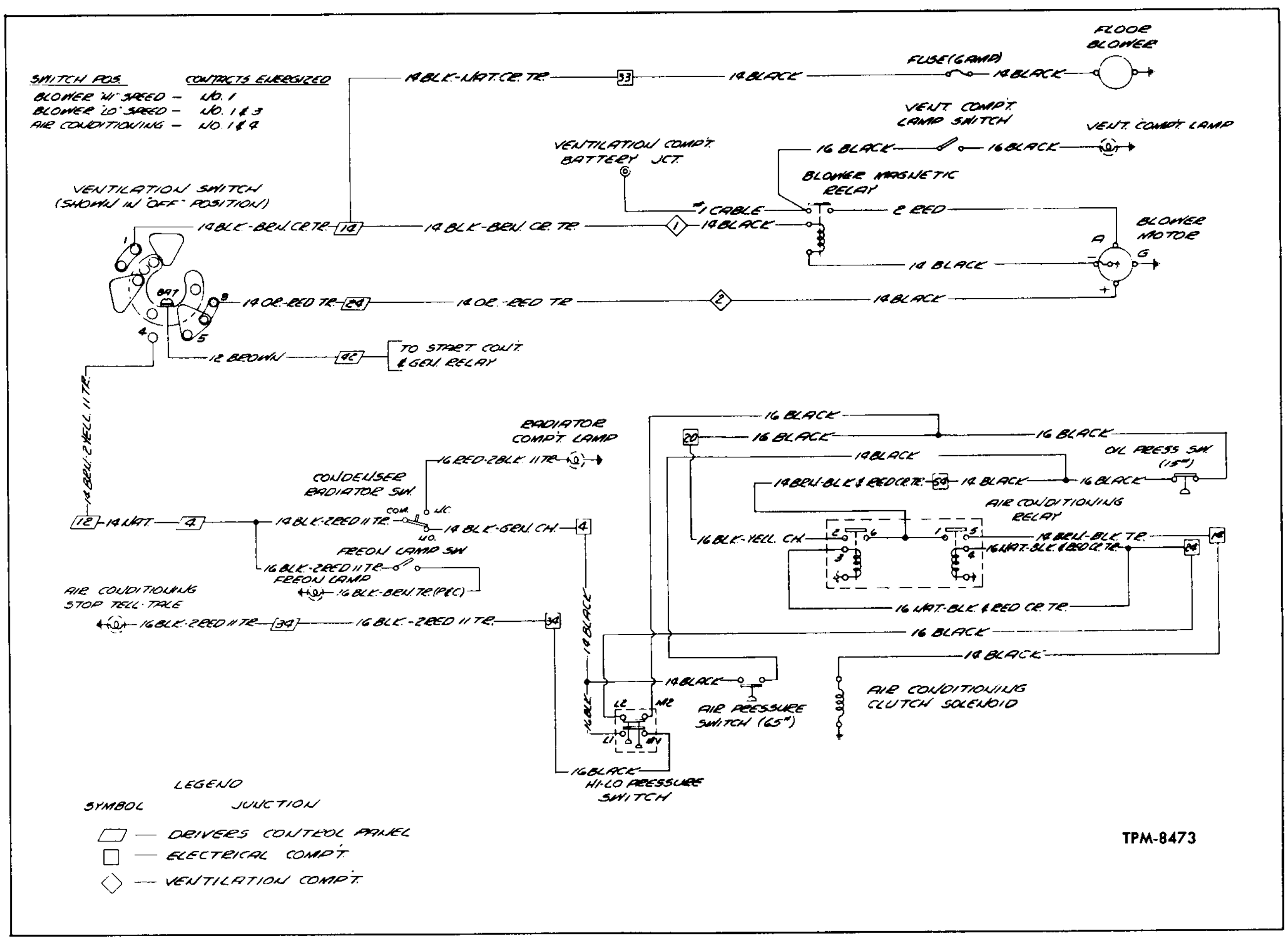


Figure 2—Simplified Schematic Wiring Diagram

left of driver is placed in "AIR CONDITION" position, the air conditioning system functions as follows:

NOTE: Follow the schematic wiring diagram (fig. 2) for simplified electrical circuits and connections.

1. With engine running and control switch closed, underfloor blower high speed circuit is energized and blower runs continuously at high speed.

2. The engine must be running at idle speed, and the air pressure in coach air system must be more than 65 psi to close low air pressure switch before circuit through the refrigerant "HI-LO" pressure switch is completed to operating coils of air conditioning control relay. Relay is located in electrical compartment at right rear side of coach. With relay operating coils energized, contacts close and circuit is completed to the air conditioning drive clutch solenoid valve. Solenoid valve is located in compressor compartment.

3. Air conditioning control relay is a lock-in type unit; that is, after operating coils are energized and contacts close, contacts will remain closed as long as the circuit through the contacts is not broken. Either of six conditions can break the circuit and cause relay contacts to open:

a. Too high or low refrigerant pressure.
b. Coach engine stops running.
c. Generator system fails.
d. Low air pressure (below 65 psi).
e. "VENTILATION" switch not in "AIR CONDITION" position.
f. Condenser coil not latched properly.

4. The purpose of the lock-in feature of the air conditioning drive control relay is to maintain circuit to air conditioning clutch solenoid valve after the oil pressure safety switch opens. Oil pressure safety switch opens at 15 psi oil pressure (600 engine rpm). Purpose of this switch is to prevent engagement of air conditioning compressor drive clutch, if driver should turn control switch to "AIR CONDITION" position with engine running at 600 rpm or more.

FUNDAMENTAL PRINCIPLES OF REFRIGERATION

The principle of operation of the refrigeration system is based on a few simple laws of physics which are stated informally as follows:

1. Temperature is a measurement of the intensity of heat.

2. Heat is a form of energy. When heat is added to a substance, it usually is noticed by an increase in temperature. For example, in order to raise the temperature of water from 35°F. to 100°F., it is necessary to add a certain amount of heat.

3. When an object cools, it does not absorb cold, but rather it loses heat to a colder object or substance nearby. When a bottle containing warm liquid is placed on a cake of ice, the ice will melt and the bottle and its contents will become cool. Heat from the bottle and its contents is lost to the ice.

4. When a liquid boils, turning to vapor, it absorbs a great amount of heat. For instance, water boiling on a stove is absorbing a great amount of heat from the burner as it is changing to the vapor commonly called steam. Boiling is a rapid form of evaporation.

When a liquid boils, it absorbs heat without changing temperature. For example, when heat is added to water at sea level, as when heating on a stove, the temperature of the water will rise until it reaches 212°F. If the water remains on the hot stove, it will boil, but the temperature will remain at 212°F. The heat being absorbed by the water is changing it to steam rather than raising the temperature.

Refrigerant-12 used in air conditioning system, boils at 21.8°F. below zero. Thus, if it were exposed to the air at normal room temperature, it would absorb heat from surrounding air and boil, immediately changing to a vapor.

5. When heat is removed from water vapor, it will condense back into a liquid. For example, the steam caused by boiling water on a stove will condense into water on the underside of the cover. This is due to the fact that the cover is not as hot as the steam. The cover, therefore, takes heat from the steam, condensing it back to water.

6. The temperature at which substances will boil or condense is affected by pressure. If the pressure is increased, the liquid will not boil until a higher temperature is reached. Thus, we can prevent refrigerant from boiling if it is kept under high pressure. If this high pressure is suddenly released, refrigerant will immediately boil. This has been demonstrated in modern vehicles with pressure cooling systems.

When the pressure of a vapor is increased, the temperature at which it will condense is also raised. Steam condenses below 212°F., if heat is removed from it, but it can be made to condense at higher temperature by increasing the pressure.

7. Compressing a vapor increases its temperature. For example, when pumping air into a tire with hand pump, the pump will become warm due to the heating of the air as it is compressed.

8. When a liquid is heated until it is converted to a gas, then this gas is heated additionally without changing pressure, the gas is said to be superheated. For instance, in the evaporator refrigerant absorbs heat and boils at a constant temperature and pressure until it has been completely vapor-

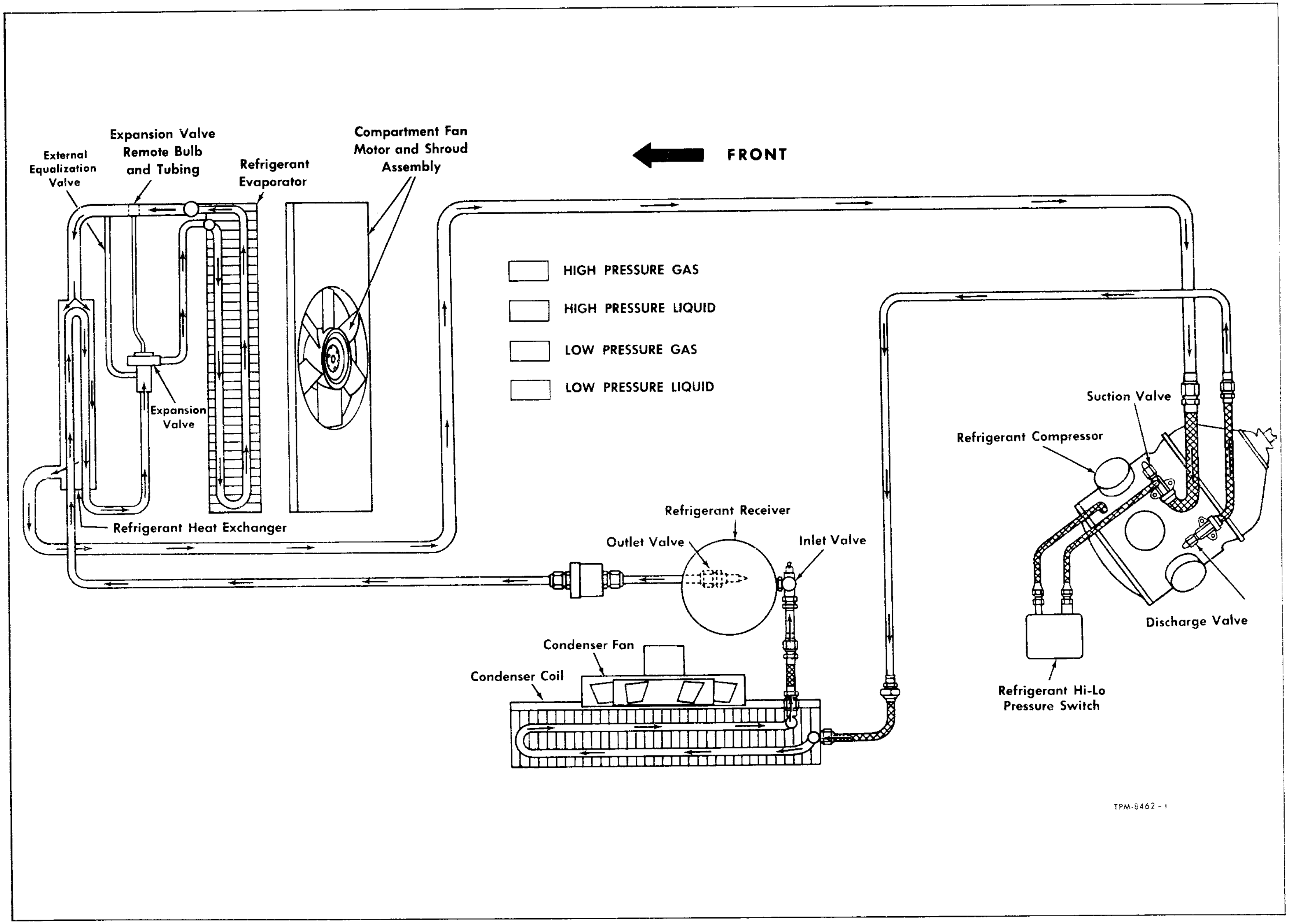


Figure 3—Schematic of Refrigerant Controls and Lines Showing High and Low Pressures

ized, and it continues to absorb heat from the warm air passing over the evaporator without any increase in pressure. Since this heat is no longer being used to convert the refrigerant from a liquid to a gas, it will now cause the temperature of the refrigerant gas to rise. The refrigerant is then superheated.

REFRIGERANT

The refrigerants used are commonly known by their trade name of Freon-12, Isotron-12, or Genetron-12. Regardless of brand, refrigerant-12 must be used. The chemical name of refrigerant-12 is dichlorodifluoromethane (CCl_2F_2).

REFRIGERANT CHARACTERISTICS

Refrigerant exists as a gas at atmospheric pressure and must be held under pressure to remain liquid. At ordinary temperatures, it will exist as a liquid under a pressure of about 75 pounds per square inch.

Refrigerant has very little odor, but in large concentrations a distinct odor may be detected. It is colorless in both its liquid and gaseous states.

Refrigerant is nonpoisonous, nonflammable, and nonexplosive. It is noncorrosive to any of the ordinary metals.

Goggles should be worn whenever there is the slightest possibility of refrigerant coming in contact with the face or eyes, because refrigerant evaporates and cools so rapidly it will cause an injury similar to frostbite.

PROCUREMENT

Refrigerant is shipped and stored in metal drums. It is serviced in one size, a 25 lb. drum.

It will be impossible to draw all the refrigerant out of the drum. The use of warm water when charging the system will assure the extraction of a maximum amount of refrigerant from the drum. Be sure to follow the instructions under "Charging The System" explained later. NOTE: Approximately 35 lbs. of refrigerant is required in system.

PRECAUTIONS IN HANDLING REFRIGERANT

1. Do not leave drum of refrigerant uncapped.
2. Do not subject drum to high temperature.
3. Do not weld or steam clean on or near system.
4. Do not fill drum completely.
5. Do not discharge vapor into area where flame is exposed.
6. Do not expose eyes to liquid.

All refrigerant drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for the same reason. If the drum is exposed to the radiant heat from the sun, the resultant increase in pressure may cause the safety plug to release or the drum to burst.

For the same reason, the refrigerant drum should never be subjected to excessive temperature when charging a system. The refrigerant drum should be heated for charging purposes by placing in 125°F. water. Never heat above 125°F. or use blowtorch, radiator, or stove to heat the drum.

Welding or steam cleaning on or near any of the refrigerant lines or components of the air conditioning system could build up dangerous and damaging pressures in the system.

If a small drum is ever filled from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. Weighing drums before and during the transfer will determine fullness of drums.

Discharging large quantities of refrigerant into a room can usually be done safely as the vapor would produce no ill effects. However, this should not be done if the area contains a flame-producing device such as a gas heater. While refrigerant normally is nonpoisonous, heavy concentrations of it in contact with a live flame will produce a poisonous gas. The same gas will attack all bright metal surfaces.

One of the most important cautions concerns the eyes. Any liquid refrigerant which may accidentally escape is approximately 22°F. below zero. If liquid refrigerant should touch the eyes, serious damage could result. Always wear goggles to protect the eyes when opening refrigerant connections. Open connections slowly.

TREATMENT IN CASE OF INJURY

Should liquid refrigerant come in contact with the skin, injury should be treated the same as if skin were frost-bitten or frozen. Should liquid refrigerant get into the eyes, a good eye specialist should be consulted immediately. Avoid rubbing or irritating the eyes. Give the following first aid treatment as soon as possible.

1. Drops of sterile mineral oil (obtainable at any drug store) should be introduced into the eyes. The mineral oil will absorb the refrigerant.

2. Eyes should then be washed, if irritation continues at all, with one of the following:

a. A weak boric acid solution.

b. A sterile salt solution not to exceed 2% sodium chloride (table salt).

3. If irritation continues for a period longer than 12 hours, eyes should be treated for secondary infection with 10% Argyrol solution or with 1% Mercuric Oxide ointment.

REFRIGERANT CIRCULATION

Refrigerant control units and piping is illustrated in figure 3. A complete cycle of the refrigerating system is as follows:

1. Refrigerant in its gaseous state is drawn into the compressor where it is compressed and discharged into the condenser.
2. As the heated gas circulates through the condenser coils, it is cooled by air being forced through the condenser by a hydraulically-driven fan. The combined effects of the decreased temperature and increasing pressure cause the gas to condense (liquify).
3. The liquid refrigerant is then forced from condenser into the liquid receiver.
4. By its own pressure, liquid refrigerant is forced from liquid receiver through the dehydrator strainer, then through the heat exchanger where it is cooled somewhat by the returning suction line low pressure gas. It then passes through the expansion valve into the evaporator.
5. In the evaporator, where the pressure is reduced, the liquid refrigerant evaporates, or changes into its gaseous state. As the liquid evaporates, heat is absorbed from the air passing through the evaporator coils, thus the air is cooled.
6. Flow of refrigerant into the evaporator is regulated by the expansion valve. The expansion valve is actually a pressure reducing valve which serves two purposes: a - It maintains pressure on the liquid line. b - It admits only the required amount of liquid refrigerant into the evaporator, this requirement being determined by the temperature of the gaseous refrigerant at the evaporator outlet.
7. The low pressure refrigerant gas passes from the evaporator through the heat exchanger and back through the suction line to compressor thus completing the cycle.

NOTE: Gauges for checking pressures in the refrigerant system can usually be obtained from a local refrigeration service and supply dealer.

AIR CIRCULATION

With "VENTILATION" switch on control panel in "AIR CONDITION" position and with a minimum of 65 psi air pressure to compressor clutch control, the compressor will operate and the underfloor blower will run continuously at high speed.

Blower draws outside air into heating and cooling compartment through two perforated openings - one each side of coach just below windows. The outside air is blended with recirculated air which enters same heating and cooling compartment through screened openings in the floor, one each side of aisle. This blended air is then drawn by blower through a screen where it is filtered, through evaporating coil where it is cooled and dehumidified, and then through the heater core unit where the temperature is raised to comfort level to extent determined by the control Grad-U-Stat or thermostat unit. Tempered air then flows into coach interior through vertical duct vents located below the windows.

OPERATION OF ELECTRICAL CONTROL UNITS

Refer to "HEATING SYSTEM" (SEC. 3) for operating information on controls such as: Grad-U-Stat (thermostat), air pressure regulating valve, blower motor, blower motor relay, water valve and heating system water pump.

"VENTILATION" CONTROL SWITCH

Control switch marked "VENTILATION" on control panel is a four-position rotary-type switch.

With switch in "AIR CONDITION" position, the circuit to underfloor blower is energized causing motor to operate at high speed, and circuit is completed through the "HI-LO" refrigerant pressure switch. Circuits are shown in figure 2.

AIR CONDITIONING CONTROL RELAY

Air conditioning drive control relay is located in the apparatus box at right rear of coach as shown in figure 6 in "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7).

Relay serves to close electrical circuit to compressor drive clutch air solenoid valve causing valve to open, allowing air pressure to clutch.

Relay is a lock-in type unit; that is, after operating coils are energized and contacts close, contacts will remain closed as long as the circuit through the contacts is not broken. Either of six conditions can break the circuit and cause relay contacts to open:

1. Excessive high or low refrigerant pressure.
2. Engine stops running.
3. Low air pressure (below 65 psi).
4. "VENTILATION" switch turned to "OFF."
5. Generator system fails.
6. Condenser coil not latched properly.

The purpose of the lock-in feature of the air conditioning control relay is to maintain circuit to air conditioning clutch solenoid valve after the engine oil pressure safety switch opens.

ENGINE OIL PRESSURE SAFETY SWITCH

Engine oil pressure safety switch is mounted in manifold on engine bulkhead. See item 2 on figure 2 in ENGINE (SEC. 8).

With engine running and oil pressure at 15 psi or more, contacts of safety switch are opened. Purpose of switch is to prevent engagement of air conditioning compressor drive clutch if driver

should turn control switch to "AIR CONDITION" position with warm engine running above 600 rpm.

CLUTCH CONTROL AIR PRESSURE SWITCH

Air pressure switch is mounted at left end of bulkhead forward of the refrigerant compressor (fig. 4). Purpose of switch is to prevent compressor drive clutch slippage which could be caused by insufficient operating air pressure.

Contacts of switch close when the air pressure in coach air system exceeds 65 psi. Switch completes circuit from No. 4 terminal of "VENTILATION" switch on control panel at left of driver, through the condenser coil door safety switch, the air pressure switch to the engine oil pressure safety switch, and to the refrigerant "HI-LO" pressure switch, then to the air conditioning control relay as shown on wiring diagram (fig. 2).

COMPRESSOR DRIVE CLUTCH
AIR SOLENOID VALVE

Compressor drive clutch solenoid valve (fig. 4) is mounted on bulkhead forward of the refrigerant compressor.

Air valve is an electrically-operated valve which controls flow of air pressure for the operation of compressor drive clutch. Circuit to valve is controlled by the air conditioning control relay mounted in electrical apparatus compartment at right rear of coach.

With valve coil energized, air pressure is permitted to pass through valve and flexible line to engage the compressor clutch mechanism. When valve is de-energized by action of control relay, air pressure is exhausted from clutch drive mechanism to disengage clutch.

REFRIGERANT "HI-LO" PRESSURE SWITCH

Definite high and low refrigerant pressures are established at which the system will operate efficiently and safely. "HI-LO" pressure cutout switch is provided to prevent operation of system when pressures exceed these limits. The switch is located in compressor compartment (fig. 4). Switch is connected to high and low refrigerant pressures at the compressor valves. Current from "VENTILATION" switch is routed through the "HI-LO" pressure switch. Whenever the high or low refrigerant pressure exceeds limits, the switch interrupts compressor clutch controls to stop compressor. When this occurs, another set of contacts within control relay close to complete circuit from "VENTILATION" control switch to the "A/C STOP" tell-tale on gauge panel. Tell-tale, when illuminated, indicates that compressor is not operating. When refrigerant pressures normalize to the switch cut-in point, compressor clutch control circuit is again completed and the compressor becomes operative.

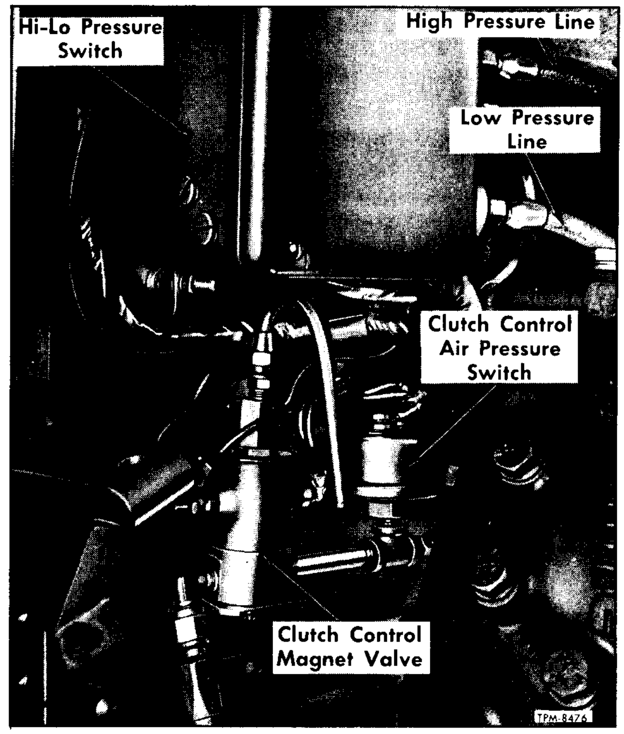


Figure 4—Clutch Control Air Solenoid Valve, and Air Pressure Switch

A/C SAFETY SWITCH IN CONDENSER COMPARTMENT

Safety switch of dual-contact type is located on condenser compartment forward bulkhead post (fig. 5). One set of contacts open to break the compressor operating circuit whenever the hinged condenser coil assembly is not in its completely closed position. At the same time, the second set of contacts close to complete A/C circuit to the condenser compartment lamp bulb only. Switch mounting is adjustable by means of lock nuts each side of switch mounting as shown.

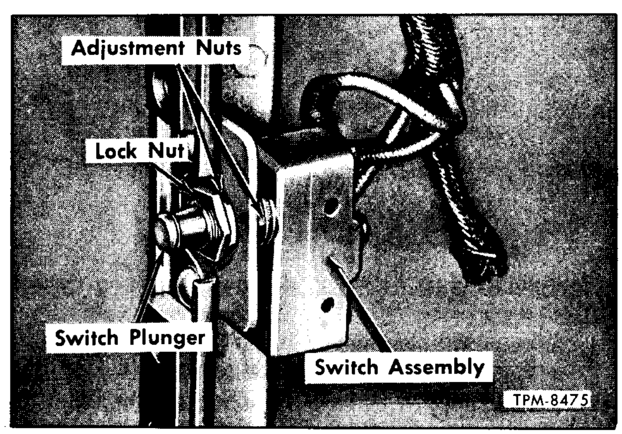


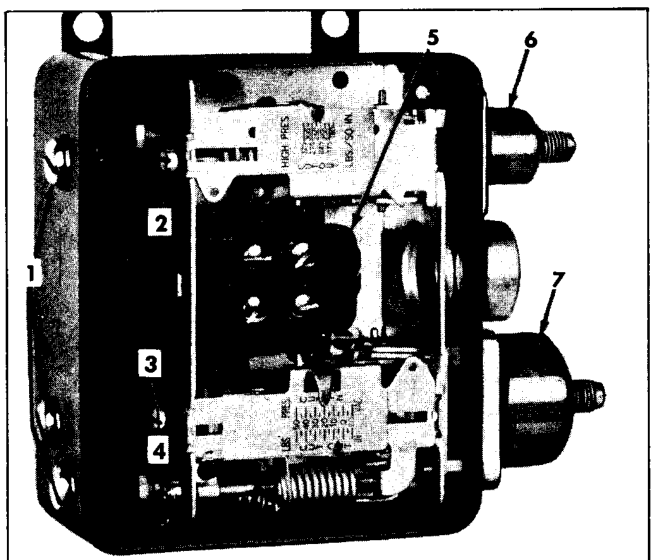
Figure 5—A/C Safety Switch in Condenser Compartment

System Maintenance

CONTENTS OF THIS SECTION

REFRIGERANT HI-LO PRESSURE SWITCH

The "HI-LO" pressure switch (fig. 6) is a dual pressure control switch connected in series with the air conditioning control circuit, and actuated by the high side and low side refrigerant pressures. The control unit consists basically of two bellows, both of which are connected through spring-loaded toggle linkage to a set of contact points, all enclosed within a dust-proof case.



1 Access Plugs
2 High Pressure Cut-out Adjustment
3 Low Pressure Range Adjustment
4 Low Pressure Cut-out Adjustment
5 Contact Assembly
6 High Pressure Bellows
7 Low Pressure Bellows

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Figure 6—Refrigerant Hi-Lo Pressure Switch

Low pressure cut-out and cut-in points are adjustable; high pressure cutout point is adjustable but the differential on the high pressure side of switch is fixed and nonadjustable. Openings are provided in side of case to permit making adjustments with a straight screwdriver.

All four wire terminals, L1, L2, M1, and M2 are used on this installation. Either of the two bellows assemblies and the contact assembly are replaceable. When connecting lines to either bellows, it is extremely important to use a wrench on hex portion of bellows element while tightening hose fitting to prevent damaging bellows.

The "HI-LO" pressure cut-out switch is properly set at the factory and should not normally require adjustment in the field. However, in the event of improper operation, switch operation can be tested and adjusted, if necessary, as follows:

LOW PRESSURE TEST AND ADJUSTMENT

Low pressure cut-out is an extremely important adjustment. System will not function satisfactorily and possible damage to compressor may result if switch points fail to open near the designated pressure. In making the following test, an accurate compound (pressure and vacuum) gauge should be used.

NOTE: A gauge set for checking refrigerant pressures can usually be obtained from local refrigerant sales and service dealer.

1. Remove cap from suction valve test gauge fitting, then connect gauge at low pressure line to fitting. Have an assistant close suction valve slowly on top side of compressor by turning valve stem in (clockwise) until valve seats.

2. Start coach engine and operate compressor, then observe pressure reading on gauge at the instant compressor clutch becomes disengaged and compressor stops. Switch points should open to disengage clutch at 7 psi gauge pressure.

3. Next allow pressure to build up until compressor clutch becomes engaged. Pressure reading on gauge when switch points close and complete circuit to compressor clutch drive should be 22 psi.

4. If switch points do not open and close at gauge readings specified in Steps 2 and 3, adjust as follows:

a. Remove switch cover, and remove adjusting screw hole plugs from side of case.

b. If only the cut-out point requires adjustment, turn adjusting screw "4." Indicator is calibrated in increments of 5 psi.

c. If the cut-in point requires adjustment, turn adjusting screw "3," which changes the cut-in and cut-out points an equal amount, then re-adjust cut-out point by turning screw "4."

d. After adjusting, recheck operation of unit as described above, then open suction valve at top of compressor.

HIGH PRESSURE TEST AND ADJUSTMENT

The high pressure side of the switch should open the points and disengage the compressor clutch at 250 psi gauge pressure, and should permit the points to close when pressure drops to 200 psi. The point at which the switch cuts out is adjustable, but the cut-in point is not adjustable. Test switch and adjust if necessary as follows, using an accurate high pressure gauge:

1. Remove cap from discharge valve test gauge fitting, then connect gauge set high pressure line to fitting.

2. With both the suction and discharge valves in operating position (cracked 1/2 to 1 turn away from backseated position), operate compressor. Have an assistant slowly close the discharge valve by turning valve stem clockwise and observe pressure reading on gauge the instant the compressor stops. If gauge reading when compressor stops is more or less than 250 psi, adjust by turning adjusting screw "2." CAUTION: If high pressure switch fails to disengage compressor clutch when pressure reaches 275 psi, stop compression, as pressures in excess of this may damage other units.

3. Have assistant open discharge valve, then repeat test 2 above to recheck cut-out adjustment.

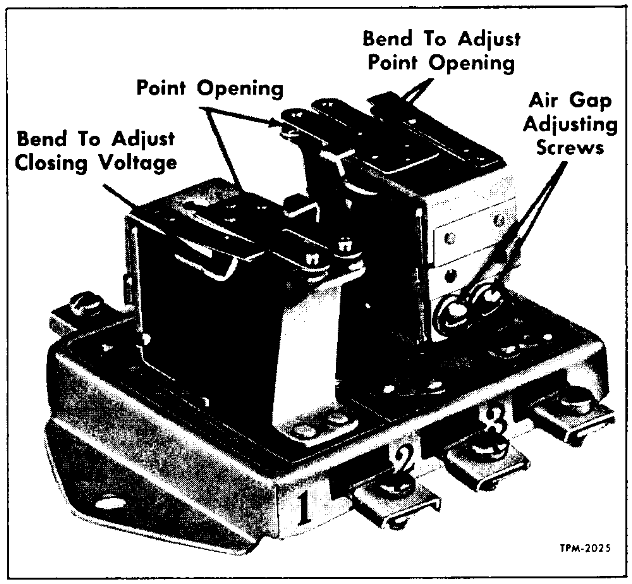


Figure 7—Air Conditioning Control Relay

4. When pressure cut-out switch stops the compressor at correct pressure, continue to operate coach engine and air conditioning system until pressure equalize, then observe reading on pressure gauge when circuit is completed to compressor clutch drive. If switch does not permit points to close at 200 psi gauge pressure, the complete control unit should be replaced.

5. After completing tests and adjustments, install cover and hole plugs.

PRESSURE SWITCH REPLACEMENT

1. Pump down system as directed later under "SYSTEM SERVICES AND TESTS."

2. Back-seat compressor suction valve to close line to low pressure fitting at switch.

3. Disconnect refrigerant pressure lines and immediately cap line fittings to seal moisture and air from system.

4. Reverse the above procedure to install pressure switch.

5. After installing switch assembly, place system back in operating position, then vent or crack line connections at switch. Tighten connections firmly after venting. NOTE: If system was left open for any extended period of time it may be necessary to purge system.

AIR CONDITIONING CONTROL RELAY

Air conditioning control relay, mounted on electrical apparatus panel at right rear of coach, controls the compressor clutch solenoid valve. Relay installed is shown in figure 2 of WIRING AND MISCELLANEOUS ELECTRICAL (SEC. 7). Figure 7 shows relay with cover removed.

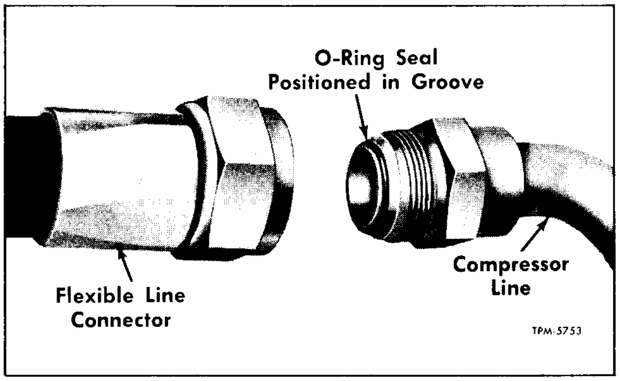


Figure 8—Refrigerant Line O-Ring Seal Installed

Terminal No. 2 is fed through both air conditioning control engine oil pressure switch from the "VENTILATION" control switch located on panel at left of driver.

Terminal Nos. 1 and 6 are fed by same circuit except that circuit does not flow through the engine oil pressure switch.

Terminal Nos. 3 and 4 are connected to relay operating coils. Terminals are fed from the No. 2 terminal of relay after current flows through closed contacts of first the low air pressure switch and then the low pressure contacts of the refrigerant "HI-LO" pressure switch.

Relay circuits are shown on figure 2 or on Wiring Diagram in back of this manual.

Terminal identification numbers shown on Wiring Diagram are stamped on base of relay at side of terminals.

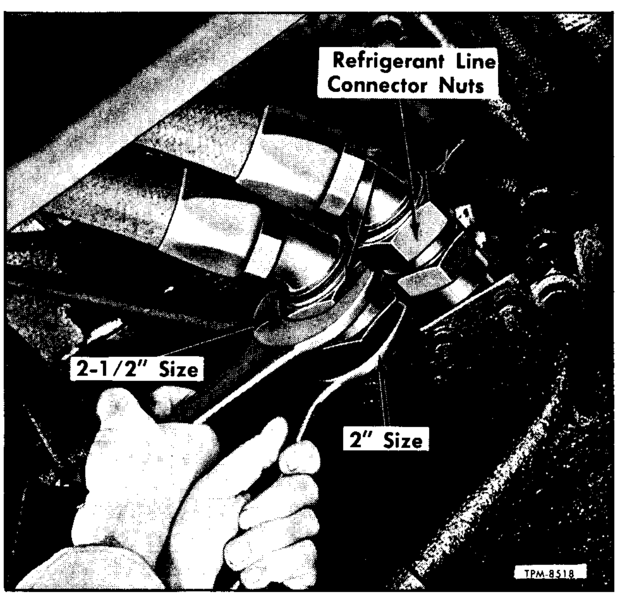


Figure 9—Using Wrenches at Line Connection

RELAY ADJUSTMENTS

NOTE: Relay adjustment points are shown in figure 7.

Air Gap

Disconnect wires from terminal Nos. 2 and 5 and remove cover from relay. Press armature down until points just close, then measure air gap between armature and center of core. Air gap should be 0.014". Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required.

Point Opening

With wires still disconnected from terminal Nos. 2 and 5, measure clearance between points with armature up against stop. Clearance should measure 0.028". Adjust point opening, if necessary, by bending the armature stop. Make sure opening at both points are equal and that points close simultaneously when armature is depressed. After completing adjustment, connect wires to terminal Nos. 2 and 5.

Closing and Opening Voltage

Check each unit separately by connecting an accurate reading voltmeter parallel with each operating coil circuit. Connect voltmeter from No. 3 terminal to ground for one unit and from No. 4 terminal to ground for the other unit. Also connect a variable resistance unit in series with the operating coil circuit at the same terminal to which the voltmeter is connected. Close the switch which controls the operating coil circuit of the unit being checked. Slowly decrease resistance and note voltmeter reading when points close. Points should close between 8.5 to 10.5 volts. If not within the range, adjust by bending the armature spring post. Increase spring tension to increase closing voltage and decrease spring tension to decrease the closing voltage. After correct closing voltage adjustment is obtained, slowly increase resistance and note voltmeter reading when points open. If opening voltage is below 4.3 or if either unit fails to operate, replace the complete relay assembly.

REFRIGERANT LINE THREADED CONNECTIONS

A rubber O-ring seal (fig. 8) is used at refrigerant line threaded connections to assure positive seal. Break line connection using two wrenches as shown in figure 9. After breaking connection, remove old O-ring seal and install new seal in seal groove.

Before line is connected, apply clean compressor oil to O-ring seal to facilitate connection. Tighten line nut firmly. Check for leaks as explained later under "SYSTEM SERVICES AND TESTS."

IMPORTANT: Use GM replacement flexible lines - type 2603 or equivalent. Other types of lines may or may not meet the necessary requirements of this system.

REFRIGERANT LINE SOLDERED JOINTS

Clean surfaces to be soldered using No. 00 steel wool, then apply thin coat of "Nokorode" flux. Sweat connection with special 95% tin and 5% antimony solder.

CLUTCH CONTROL AIR SOLENOID VALVE

Solenoid valve assembly is constructed as shown in figure 10. Foreign substances, present in compressed air system, may enter solenoid valve and injure valve faces and seats sufficiently to permit air leakage past valve rubber inserts when valves are seated. This condition may be detected easily on vehicle or on bench by testing valve ports with soap suds.

Valve assembly can be readily disassembled for cleaning, inspection, and replacement of parts.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 10.

1. Remove threaded adapter (1) and seal (2) from sleeve assembly (4), then remove thin nut (3) which retains housing and coil assembly (5) to sleeve assembly.
2. Remove housing and coil assembly (5) by sliding off upper end of sleeve assembly.
3. Using special spanner wrench (skinner No. VO-233), unscrew sleeve retaining nut (6) from valve body (10), then remove sleeve assembly (4), plunger assembly (9), and plunger spring (8) from valve body.
4. Remove sleeve nut seal (7) from valve body. Discard seals (2 and 7) and obtain new parts for assembly.

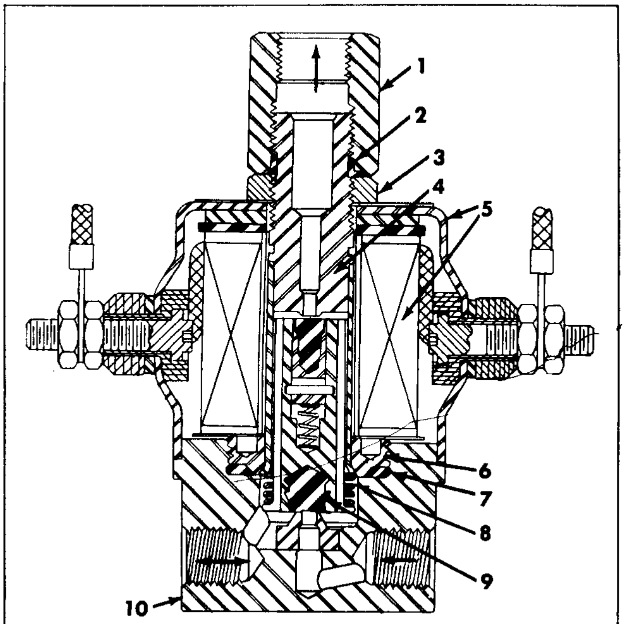
CLEANING AND INSPECTION

Wipe all parts clean with a clean cloth. Do not clean housing and coil assembly or plunger assembly in cleaning solvent. Examine rubber inserts in plunger assembly for wear or deterioration. Replace plunger assembly if damaged. Make sure valve seats on sleeve and in body are clean and smooth.

ASSEMBLY

NOTE: Key numbers in text refer to figure 10.

1. Assemble plunger spring (8) on plunger assembly (9) and position plunger in valve body.
2. Place new seal (7) in body, then install sleeve assembly (4) in body and secure with sleeve retaining nut (6). Use special spanner wrench to tighten sleeve nut.
3. Install housing and coil assembly (5) over sleeve, then install thin nut (3). Tighten nut only as necessary to seat parts solidly; overtightening will place excessive strain on sleeve assembly.
4. Place new seal (2) in groove of adapter, then install adapter (1) on sleeve. Hold nut (3) while tightening adapter.



1 Adapter	6 Sleeve Retaining Nut
2 Adapter Seal	7 Sleeve Nut Seal
3 Thin Hex Nut	8 Plunger Spring
4 Sleeve Assembly	9 Plunger Assembly
5 Housing and Coil Assy.	10 Valve Body

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Figure 10—Clutch Control Air Solenoid Valve

LIQUID REFRIGERANT RECEIVER TANK

Liquid receiver (fig. 11) serves as a reservoir for a constant supply of liquid refrigerant ready for use in the evaporator. Two sight glasses are provided at receiver; one in top of tank and one in side of tank. A light bulb, installed over upper sight glass is illuminated by operating switch located inside of side sight glass observation port, accessible within baggage compartment at rear of tank. With light on, level of refrigerant can be readily seen in sight glass. After unit has been running for 30 minutes or more, refrigerant level should be at center of sight glass. In no case should the refrigerant level be above the sight glass or below it with the system operating. Refrigerant

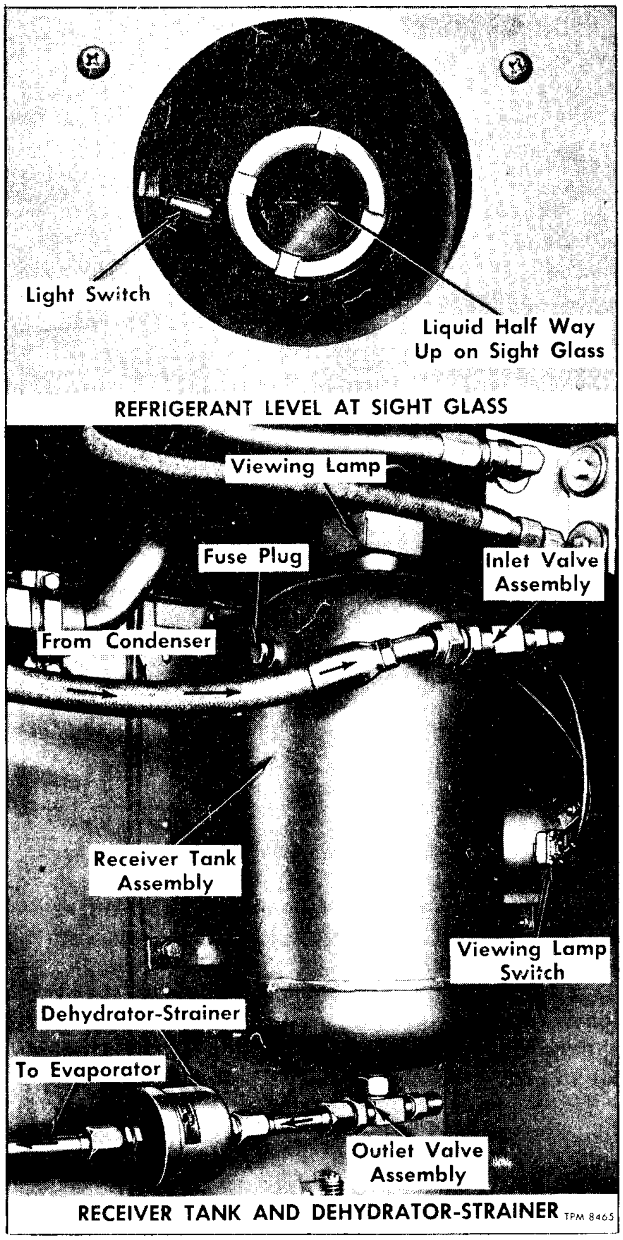
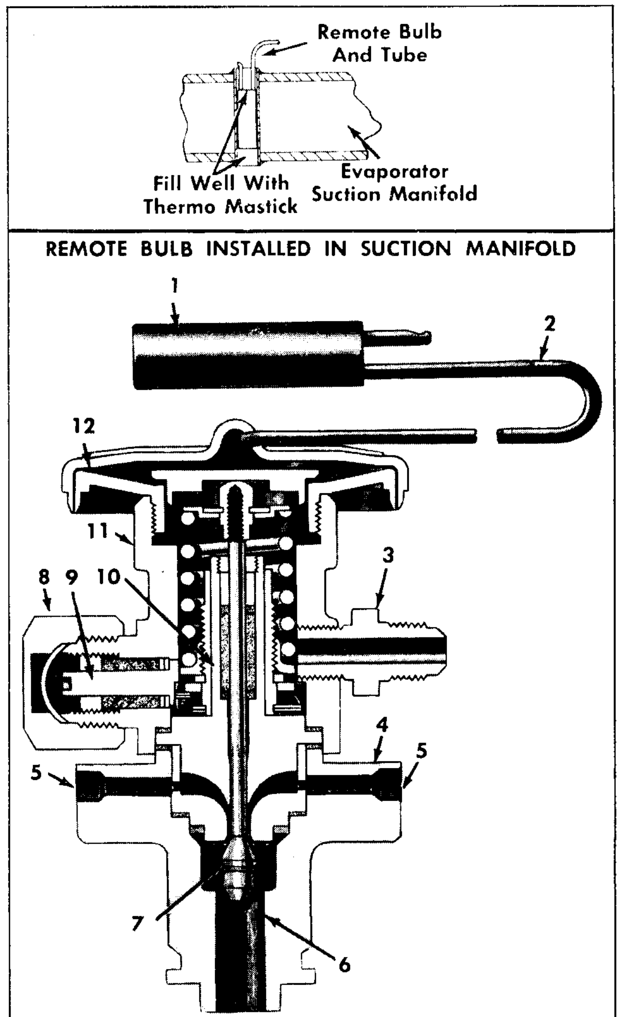


Figure 11—Refrigerant Receiver Tank, Tank Sight Glass Location, and Dehydrator-Strainer



1 Remote Bulb	7 Valve
2 Capillary Tube	8 Adjusting Stem Cap
3 Equalizer Tube Connector	9 Adjusting Stem
4 Body Flange	10 Cage Assembly
5 Outlet Ports	11 Power Assembly
6 Inlet Port	12 Diaphragm

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Figure 12—Sectional View of Expansion Valve

can be added to the system at the compressor suction valve test gauge fitting as directed in "SYSTEM SERVICES AND TESTS" later.

During operation of the system, both the receiver inlet and outlet valves must be fully open. To determine if valves are fully open, remove valve stem caps and turn valve stems counterclockwise to the limit of their travel. If air conditioning system fails to function, receiver valves should be the first place to check. The system positively will not function unless both of the receiver valves are open. A fusible safety plug (212°F.) is installed near top of receiver tank as shown in figure 11.

REFRIGERANT DEHYDRATOR—STRAINER

The refrigerant dehydrator-strainer, installed in the liquid line at left side of coach (fig. 11), removes foreign matter and moisture from the refrigerant before it reaches the expansion valve.

Strainer is of the disposable type, charged with activated alumina. The complete unit is discarded and replaced with a new unit.

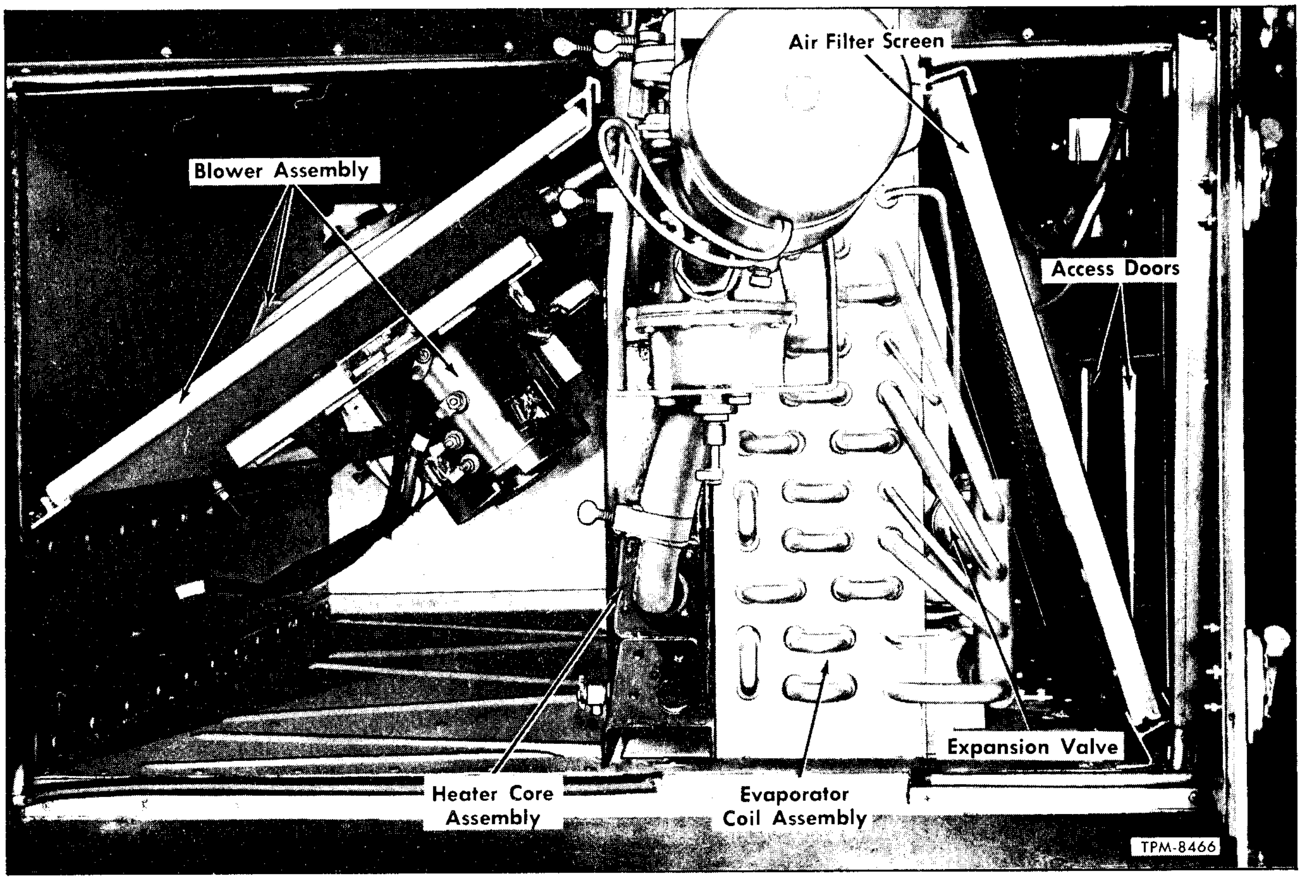


Figure 13—Cooling and Heating Compartment Inner Closure Panels Removed

Chemical used in unit has a high moisture absorbing capacity. Any moisture which has been inadvertently admitted into system will be absorbed by the chemical. This does not mean that the system should not be evacuated when air and moisture has been admitted.

Whenever the system has been opened for any reason, the dehydrator-strainer should be replaced after a few hours of operation. Instructions for replacing unit are explained later in this group under "SYSTEM SERVICES AND TESTS."

EXPANSION VALVE

Expansion valve (fig. 12) is installed in the underfloor compartment at right end of evaporator coil as shown in figure 13. Valve is accessible for servicing or replacement only after air filter screen is removed. Access to front of valve can also be gained through two access openings in bulkhead forward of valve. Expansion valve is set at the factory to provide the most efficient operation of the system, and should not normally require adjustment in the field. However, in the event a new evaporator coil and valve assembly or a new expansion valve power or cage assembly is installed, valve must be adjusted to provide the correct superheat at the evaporator outlet. In any event, do not adjust the expansion valve to compensate for insufficient cooling until all other possible causes are checked for and corrected.

EXPANSION VALVE OPERATION

Expansion valve is a manifold type thermo valve with external remote control bulb and external equalizer. Expansion valve regulates the flow of liquid refrigerant into the evaporator coils. Valve is primarily operated by the temperature of the suction gas leaving the evaporator, and is further controlled by the pressure in the evaporator through the equalizer tube. The combined effect of these two factors automatically control the quantity of liquid admitted into the evaporator. See figure 14, which shows schematic view of valve operation.

Outlet end of valve is of manifold type, which is connected by four small distributor tubes to the evaporator coils. The liquid line is connected to inlet port which extends through the center of the body flange. The remote bulb is inserted into the hollow end of the evaporator coil outlet manifold, where it is subjected to the temperature of the

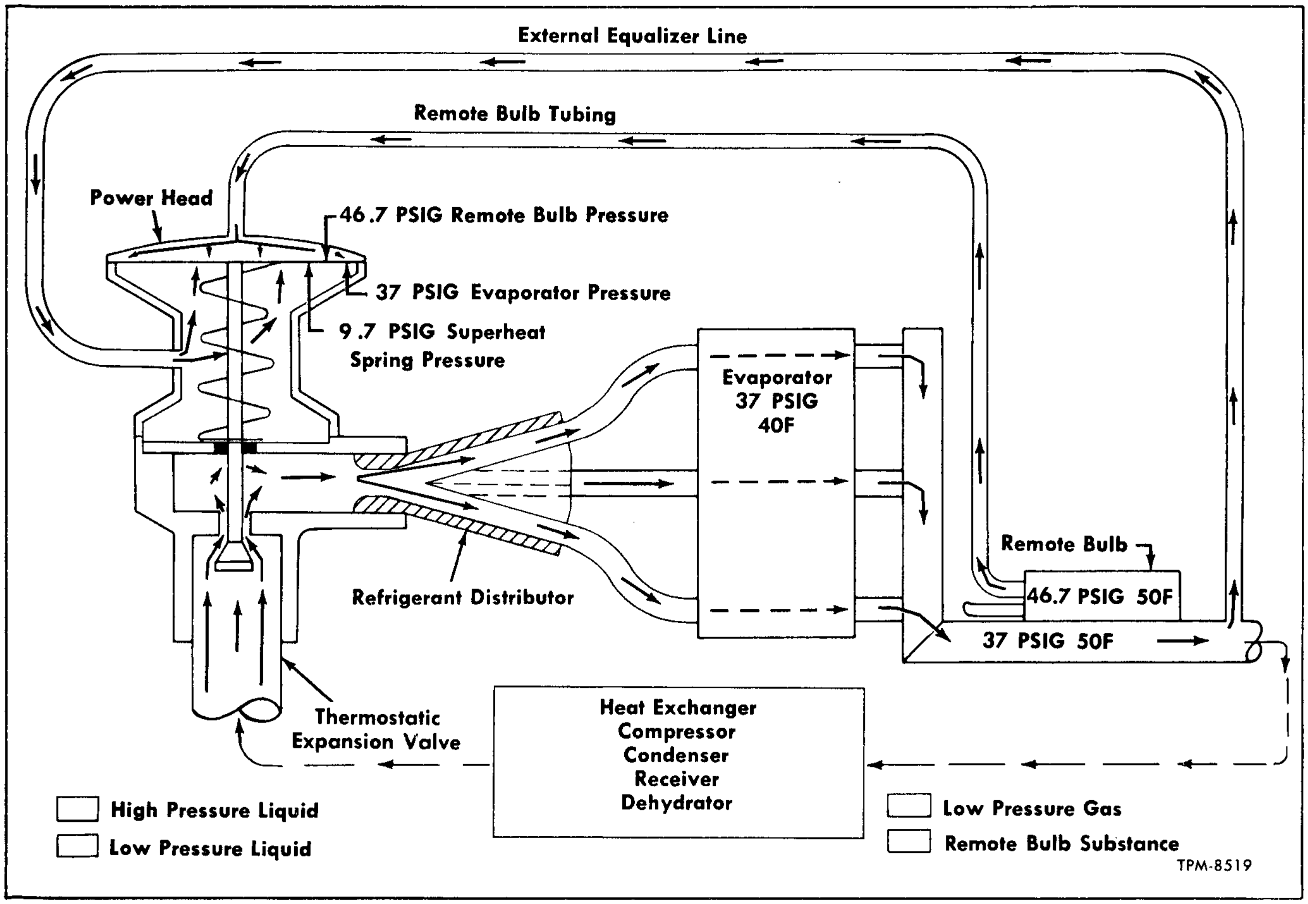


Figure 14—Simplified Operational Diagram of Refrigerant Expansion Valve (Typical)

suction gas as it leaves the evaporator. Bulb is charged with gas refrigerant which expands and contracts in accordance with the temperature of the suction gas. Expansion of refrigerant in bulb applies pressure against diaphragm in valve power assembly, causing valve to open.

Bulb tends to operate valve toward its open or closed position to regulate the flow of refrigerant into the evaporator as required. If too much liquid is admitted into the evaporator, all of it does not evaporate and some liquid approaches the remote bulb, lowering its temperature. This will cause the liquid in the bulb to contract, relieving pressure on diaphragm, and spring moves valve toward its closed position. If there is not enough liquid in the evaporator, the resulting increase in temperature of the suction gas raises temperature of bulb, causing valve to operate in its opening direction.

EXTERNAL EQUALIZER

The purpose of the external equalizer is to prevent flooding the evaporator coils when temperature of evaporator suddenly rises. Equalizer tube is connected into the evaporator coil outlet manifold and to the cavity below the diaphragm in the valve power assembly. Thus, when valve is suddenly opened wide by a high temperature in the suction gas, the heavy flow of liquid into the evaporator creates a high pressure which is carried to the underside of the diaphragm through the equalizer tube. This pressure below the diaphragm counteracts the pressure from the remote bulb and tends to move the valve toward its closed position.

CONSTRUCTION (Fig. 12)

The expansion valve has three basic component parts: The power assembly, cage assembly, and body flange. There are no working parts in the body flange. The outlet body flange is soldered to evaporator by tubes and a tube distribution manifold. Power assembly and cage assembly can be removed from the body flange without breaking any soldered connections.

Always make sure the system is clean and dry before installing the expansion valve.

SUPERHEAT

Superheat is the temperature increase of a gas, above the saturation point. When the liquid refrigerant boils or evaporates in the evaporator,

heat is absorbed from the air passing through the evaporator coils, but the temperature of the gas does not rise above the boiling point until all the liquid has changed to gas. The heat thus absorbed is the latent heat of vaporization, producing a change in state with no change in temperature.

After the refrigerant has changed to gas, the temperature of the gas is still lower than the temperature of the air passing through the evaporator, so the gas will continue to absorb heat from the air and its temperature will rise a few degrees. This amount of rise above the saturation temperature is called "superheat."

Example: At 37 psi gauge pressure, the saturation temperature of refrigerant is $40^{O}F.$; that is, the liquid changes to gas at $40^{O}F$. If the temperature of the refrigerant gas at 37 psi gauge pressure is $48^{O}F.$, the gas contains $8^{O}F.$, of superheat. Superheating takes place after all the liquid has changed to gas, usually near the outlet end of the evaporator coils.

PRESSURE - TEMPERATURE

Pressure has a very definite relationship to the boiling point of any substance. There is a definite temperature at which a liquid will boil for every definite pressure exerted upon that liquid. Water, which boils at $212^{O}F.$, under zero gauge pressure (atmospheric pressure at seat level), will boil at approximately $232^{O}F.$, under 10 psi gauge pressure.

Likewise, refrigerant-12 boils at $-22^{O}F.$ ($-22^{O}F.$, below zero) under atmospheric pressure, and at $70^{O}F$ under 70 psi gauge pressure. An increase in pressure causes a rise in boiling point.

The pressure temperature relationships shown in the table on page 18 are used for two purposes: For adjusting the expansion valve and for checking for air in the system. Method of checking for air in the system is described in "SYSTEM SERVICES AND TESTS" later in this group.

EXPANSION VALVE ADJUSTMENT

Valve should be adjusted to obtain 8^{O} to 12^{O} superheat with moderately heavy internal load. Refer to pressure-temperature chart.

1. Apply small quantity of a thermo-type mastick to a remote-reading thermometer and attach to evaporator coil outlet, as shown in figure 15. Thermo-mastick may be available at a local refrigeration service establishment, or it can be obtained from the Alco Valve Company, St. Louis, Missouri. Cover thermostat more than shown.

2. Connect a low pressure gauge at the compressor suction valve test gauge fitting. Loosen line connection at gauge and expel air from line.

3. Compare pressure reading on gauge with temperature reading on thermometer against corresponding pressure in table. If necessary, remove

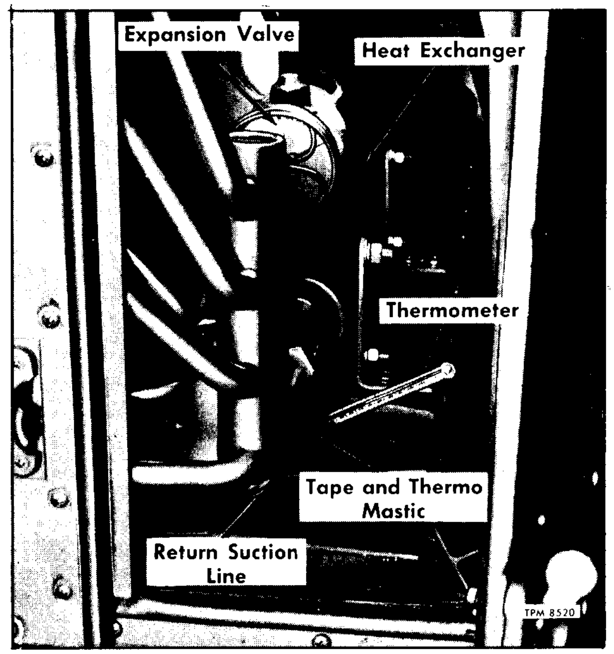


Figure 15—Checking Superheat

cap from expansion valve adjusting stem; turn valve stem clockwise to decrease flow of refrigerant and increase superheat; turn valve stem counterclockwise to increase refrigerant flow and lower superheat. Two complete turns of valve stem will change the actuating superheat approximately $1^{O}F$.

4. After adjusting, wait about 30 minutes to check results.

5. Remove gauge and line, then install protector cap on test gauge fitting.

SERVICING THE EXPANSION VALVE (Fig. 12)

When necessary to clean, inspect, or replace parts, the power assembly and cage assembly may be removed without disconnecting any soldered joints.

1. Pump down the system as directed in "SYSTEM SERVICES AND TESTS," later in this group.

2. Disconnect the external equalizer line from power assembly. Pull remote bulb out of end of evaporator coil outlet manifold. Use care to prevent kinking or otherwise damaging capillary tubing.

3. Remove two cap screws attaching power assembly to body flange, remove power assembly, then lift out cage assembly.

4. When assembling valve, replace gaskets in proper places, and be sure the retaining pin on the valve cage enters the slot in the body flange.

5. Make sure the two lugs on the valve cage fit into grooves in the power assembly, and that the gear wheel on cage assembly meshes with adjusting gear in side of power assembly. Do not

REFRIGERANT PRESSURE-TEMPERATURE RELATIONSHIP FOR REFRIGERANT 12

Temp. °F.	Gauge Pressure PSI	Temp. °F.	Gauge Pressure PSI
30	28	96	110
32	30	98	113
34	32	100	117
36	33	102	121
38	35	104	124
40	37	106	128
42	39	108	132
44	41	110	136
46	43	112	140
48	45	114	144
50	47	116	148
52	49	118	153
54	51	120	157
56	53	122	162
58	55	124	166
60	58	126	171
62	60	128	175
64	62	130	180
66	65	132	185
68	68	134	190
70	70	136	195
72	73	138	200
74	76	140	206
76	78	142	211
78	81	144	216
80	84	146	221
82	87	148	227
84	90	150	234
86	93	152	239
88	96	154	245
90	100	156	251
92	103	158	256
94	106	160	262

force the valve together - make the cage fit properly before tightening to the body flange.

CAUTION: If necessary to make soldered connections at body flange, first remove power assembly, cage assembly, and all gaskets. Keep heat away from all valve parts except the body flange.

6. Insert remote bulb into end of evaporator coil outlet manifold, making sure there are no sharp bends or kinks in the capillary tube.

EXPANSION VALVE FREEZES

Expansion valve trouble caused by moisture in system may be usually detected by an intermittent hissing sound at the expansion valve at high temperatures. Do not confuse this hissing sound with the hissing caused by a shortage of refrigerant. Excessive refrigerant causes a hissing sound accompanied by a pounding vibration. When operating at low temperatures, moisture is indicated by the above, and by the fact that when the compressor is shut down and the valve warms up, it will become operative again for a short time.

If there is moisture in the system, it is necessary to evacuate the system with a vacuum pump, then service the dehydrator-strainer. If moisture is still evident after one hour of operation, the dehydrator-strainer must be serviced again. Repeat until all moisture has been eliminated. Moisture trouble is caused by moist air entering piping when system is open, or from water in refrigerant container. Piping should be blown out with refrigerant before making final connections, particularly if piping has been open to air with high humidity content. After system has been pumped down and system opened, moisture is almost certain to be introduced. Always service the dehydrator-strainer whenever the system has been opened and service again after a few hours of operation.

Many chemical preparations to be added to the refrigerant are now offered commercially for correcting moisture trouble. These preparations are anti-freeze solutions and are not suitable for use in compressor used in this system.

THE BEST PRACTICE IS TO ALWAYS SERVICE THE DEHYDRATOR STRAINER WHENEVER THE SYSTEM HAS BEEN OPENED.

This absorbs the moisture rather than preventing it from freezing, and also eliminates the danger of corrosion of internal parts of system caused by the presence of moisture.

EVAPORATOR

Finned tube type evaporator coil assembly is mounted in heating and cooling compartment under floor (fig. 13). If the underfloor air filter screen installed forward of the evaporator is serviced frequently enough, there should be no maintenance required on the evaporator. However, if servicing the filter is neglected, some particles of dust, lint, etc., may pass through the filter; since the evaporator coils and fins are moist, these particles will cling to them. Dirt on the coils and fins acts as insulation and reduces the efficiency of the system, and when operating in humid climates, objectionable odors may develop caused by a mold-like formation or growth. In the event the evaporator does become dirty, it must be cleaned with air pressure and water and some cleaning agent which is not harmful to the aluminum tubes and fins. Since the location of the evaporator is not conducive to thorough cleaning in the vehicle, and considerable time is required for removing the evaporator for cleaning, the importance of cleaning or changing the air filter at frequent intervals should be impressed upon all maintenance personnel.

AIR FILTER SCREEN

AIR FILTER SCREEN, LOCATED IN THE UNDERFLOOR COOLING AND HEATING COMPARTMENT, MUST BE KEPT CLEAN FOR SATISFACTORY OPERATION OF AIR CONDITIONING SYSTEM.

Instructions for cleaning the air filter screen are explained under "HEATING AND VENTILATION" (SEC. 3).

UNDERFLOOR BLOWER AND MOTOR

Complete maintenance instructions on the underfloor blower and motor are covered earlier under "HEATING AND VENTILATION" (SEC. 3) of this manual.

CONDENSER COMPARTMENT

Condenser compartment is located behind screened compartment at left center side of coach. Compartment contains the condenser coil, condenser cooling fan, fan motor, dehydrator-strainer, and the refrigerant receiver tank. Figures 11 and 16 shows components of compartment.

Compartment door is equipped with a hinged-screened door. Condenser coil is hinge-mounted at rear and is latched in closed position at front. Fan, motor, and fan shroud unit is also hinge-mounted at inner side of coil and is latched firmly to coil in closed position. With latches released, shroud unit can be positioned away from condenser coil which will provide access for replacing fan or reverse flushing of condenser coil fins. Compartment door screen must be kept clean at all times as leaves, bits of paper, or other objects will restrict air flow through coil. Check and if necessary clean door screen daily when operating system.

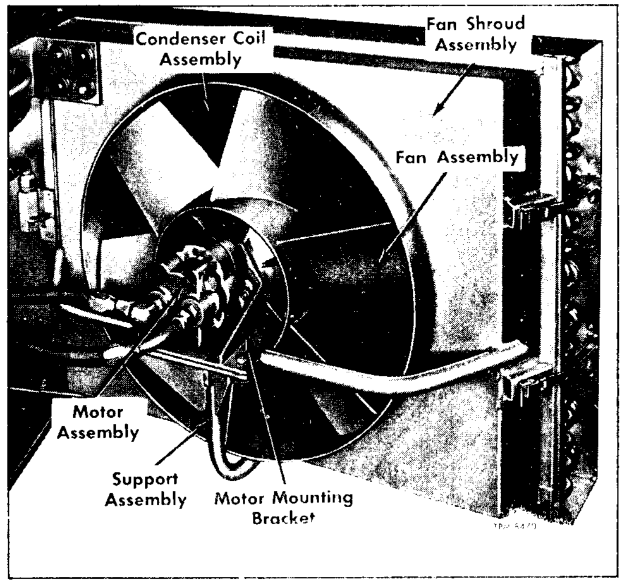


Figure 16—Condenser Coil and Fan Installed

CONDENSER

The condenser coil (fig. 16) is the medium through which the heat picked up by the refrigerant in the evaporator and the heat of compression is dissipated to the air. Since the heat in the gas must be dissipated through the walls of the coils and the fins, it is of extreme importance that the condenser be kept clean.

THE IMPORTANCE OF KEEPING THE CONDENSER CLEAN CANNOT BE OVER-EMPHASIZED. When condenser becomes clogged or coated with dirt and road film, high head pressure occurs and extra operating power is required. Condenser must be cleaned at regular intervals.

Instructions for cleaning condenser coil are explained later under "SYSTEM SERVICES AND TESTS." See "Cleaning Coils of Condenser."

CONDENSER FAN AND DRIVE

Condenser cooling fan is hydraulically driven by a fluid motor and pump. Pump connected to fan motor with two fluid lines, is mounted to bottom of refrigerant compressor and is belt-driven from compressor drive. Figure 1 schematically shows locations of system units and lines. Location of fan and motor is shown in figure 16.

Condenser fan is of six blade type and is mounted at inner side of condenser coil (fig. 16). Fan pulls outside air through the condenser coil and discharges it out through expanded metal grille at bottom of compartment.

Fan drive motor and fluid pump are of gear-type and provide variable speed corresponding with rpm of engine.

The fan blade is adjustable fore or aft on motor shaft to provide proper alignment with shroud opening. Instructions for aligning fan blade are explained later under "Fan Blade Replacement."

Fan motor is rubber-mounted to motor support as shown in figures 16 and 17.

The hydraulic fluid reservoir which contains a reserve supply of system fluid is also rubber-mounted and is located in the refrigerant compressor compartment (fig. 18).

Oil in reservoir must be kept to level half way up on sight glass at side of reservoir body. Instructions for filling reservoir are explained later under "SYSTEM SERVICES AND TESTS." See "Servicing Condenser Fan Drive Fluid System."

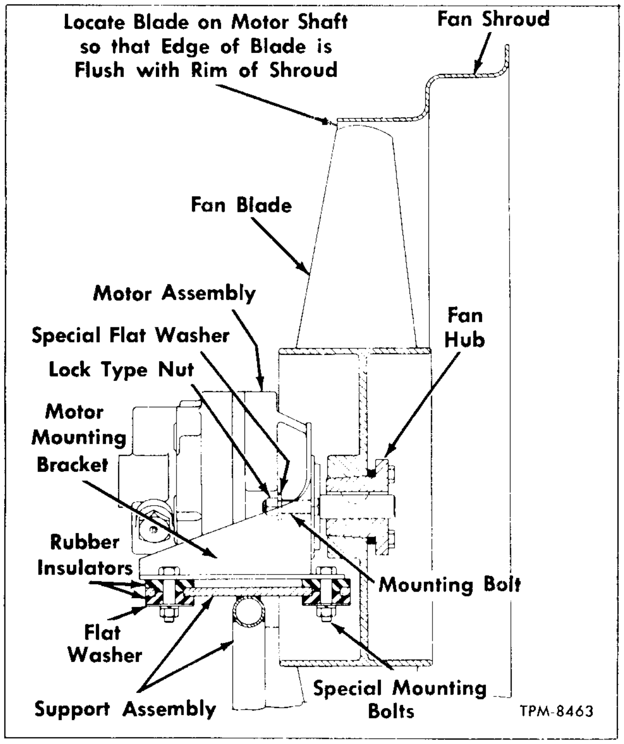


Figure 17—Condenser Fan Blade Alignment and Motor Mounting

The three V-belts which drive the fluid pump must be kept to tension specified later under "Fan Drive Maintenance." See "Belt Tension Adjustment."

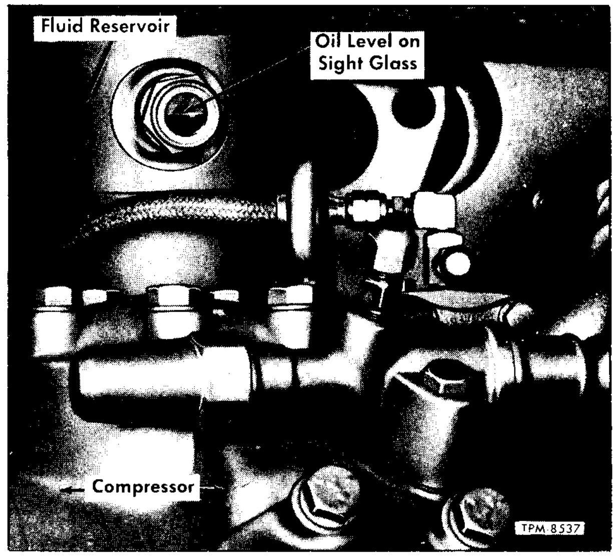


Figure 18—Condenser Fan Drive Fluid Reservoir Installed

CONDENSER FAN DRIVE

DESCRIPTION AND OPERATION

The condenser fan drive consists of two fixed displacement elements, a fixed displacement gear pump and a fixed displacement gear motor. Their displacement being alike, theoretically one revolution on the pump results in one revolution on the motor. Practically, there are slip losses in each

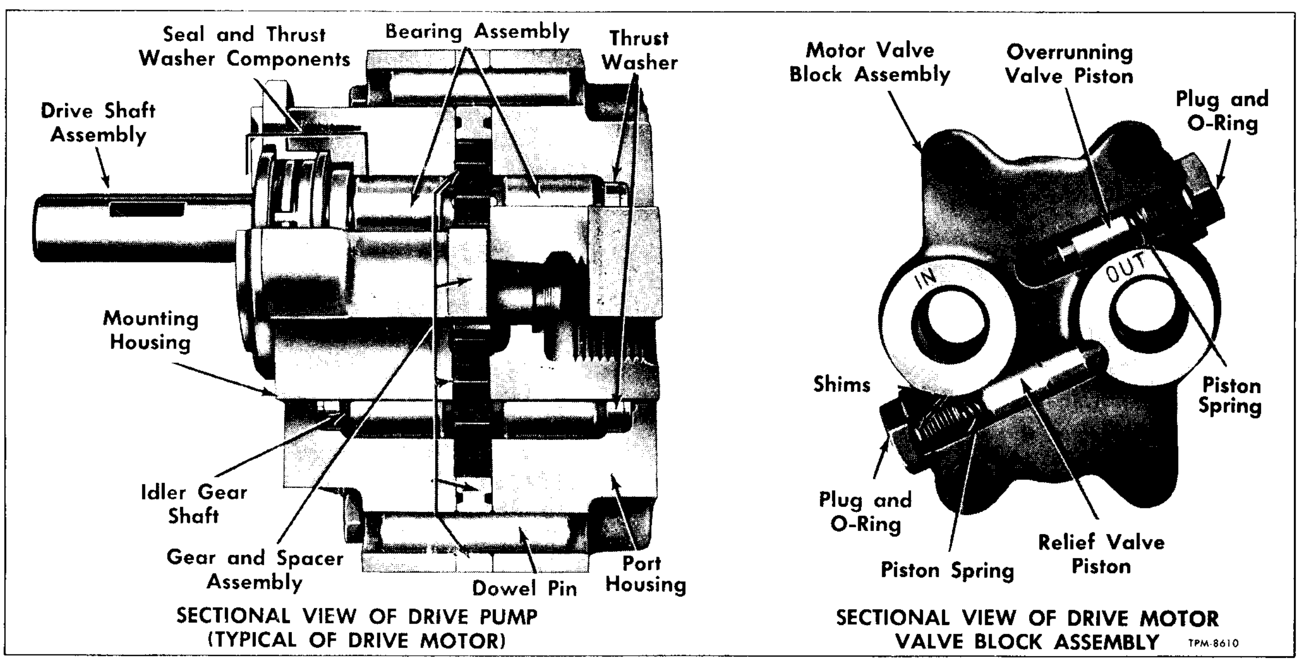


Figure 19—Cutaway View of Fan Drive Fluid Pump and Motor (Typical)

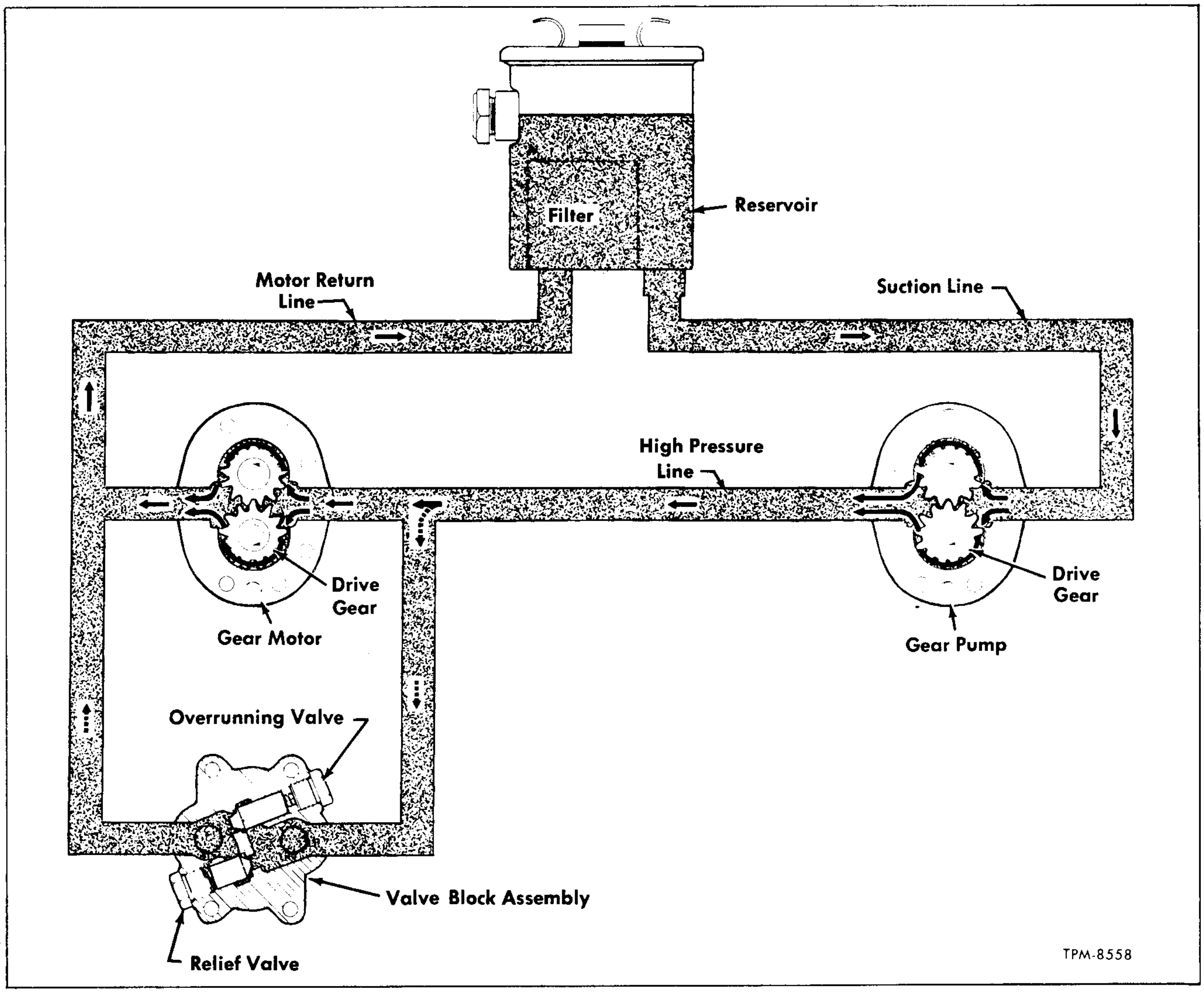


Figure 20—Schematic of Condenser Fan Fluid System

of the elements which means to obtain a given speed on the motor, the pump will have to be rotated slightly faster.

Figure 19 shows a typical cutaway view of fan pump and motor. Figure 20 shows a schematic of the condenser fan drive system.

The system is designed to maintain a given fan speed of 1700 rpm at coach cruising speed (1650 engine rpm). At speeds less than cruising, the condenser fan speed will fall in direct ratio to the engine speed.

The pump, belt-driven from the compressor shaft, runs 1.22 times the engine speed. Through this 1.22 to 1 step up this means that the pump is then running at 2020 rpm. At this speed it is desirable to have the gear motor at 1700 rpm. At speeds above cruising the load on the fan, which is approximately 3 hp, determines the maximum pressure and speed on the fan. If pressure becomes excessive at high engine speeds, motor relief valve will open to maintain a maximum of 1500 psi. At this pressure fan speed will exceed 1700 rpm.

Referring to figure 20, the valve block assembly containing the relief valve and over-running valve is actually an integral part of gear motor. The relief valve is set at 1500 psi and limits the maximum pressure. The over-running valve is normally closed and comes into operation when the engine is decelerated and the fan tends to over-run. At this time the over-running valve opens and short circuits the oil passage to keep the motor from cavitating so long as the inertia load is still on the motor.

Referring to figure 20, the pump pulls oil from the reservoir through the suction line and discharges under pressure to the gear motor. The discharge from the gear motor runs back through the filter in the reservoir.

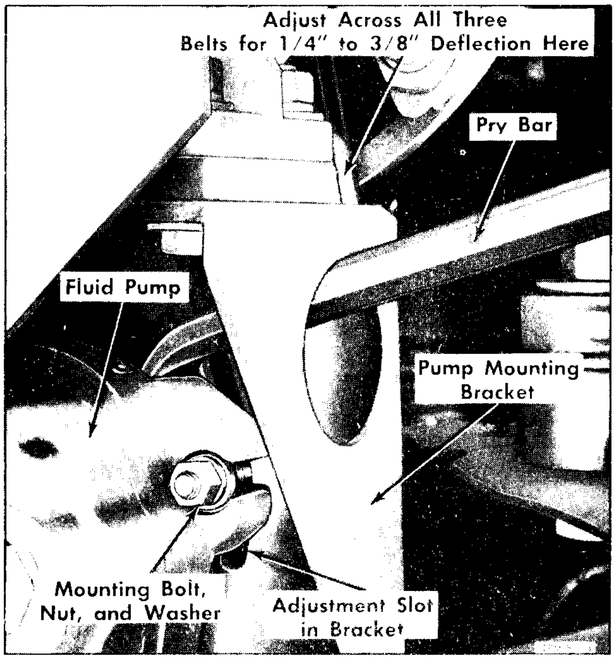


Figure 21—Checking and Adjusting Condenser Fan Drive Pump Belt Tension

CHECKING THE SYSTEM OPERATION

In checking the system operation the input speed must first be determined. Set the engine at 1650 rpm (cruising speed) and with a tachometer check output speed at the gear motor. The motor speed should be at least 1700 rpm. Also at this point the system pressure should not exceed 1500 psi. The relief valve controls the maximum pressure. While there is no adjustment for this, shims are used under the valve spring to determine the maximum setting.

It is also possible to check the motor speed at less than cruising speed. When this is done it is still necessary to know the input speed of the pump. The output speed of the motor will usually be at least 200 rpm less than the input speed of the pump.

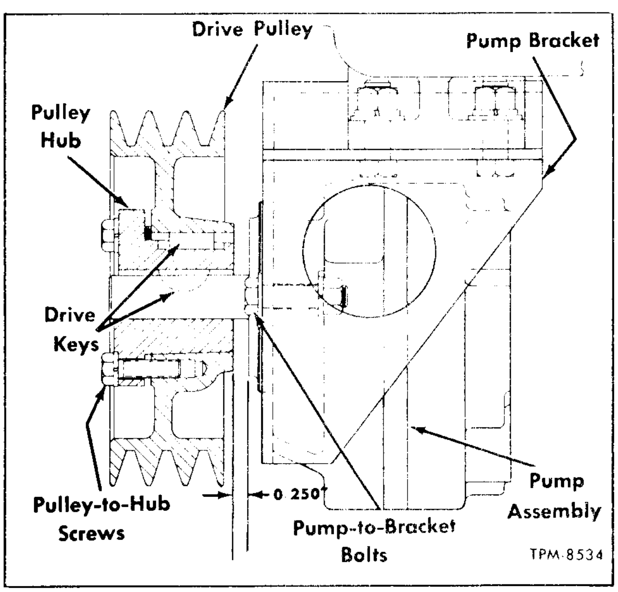


Figure 22—Condenser Fan Pump and Pulley Installation

FAN DRIVE MAINTENANCE

CONDENSER FAN HYDRAULIC DRIVE FLUID

The condenser fan hydraulic fluid level should be checked at regular coach lubrication intervals. Fluid level check is made at the system fluid reservoir which is mounted in the compressor compartment. Fluid level should be half way up on sight glass at side of reservoir (fig. 18). If necessary, add type "A" automatic transmission fluid, as explained later under "SYSTEM SERVICES AND TESTS." IMPORTANT: DO NOT OVERFILL.

Filter element in reservoir should be changed at beginning of operation season. Instructions for replacing element are explained later in this section under "Condenser Fan Fluid Reservoir."

At regular intervals all hydraulic lines and line connections should be checked for leakage. Inspect lines for possible chafing at supports to coach body. If this condition is found, lines should be repositioned and insulated. NOTE: Well insulated lines will reduce system noise.

PUMP DRIVE BELTS

Drive belts must be kept at proper tension. A loose or broken belt will affect pump operation. Belts adjusted too tight will strain and cause rapid wear of bearings in pump assembly; if too loose, belts will slip. A regular periodic inspection is recommended to check condition and tension of drive belts (fig. 21). Replace if frayed or worn.

IMPORTANT: When replacing triple V-type belts, it is essential that entire set be replaced at same time. Belts are available in matched sets only. Belts can be removed and replaced as explained later under "Pump Drive Belt Replacement."

NOTE: On a new vehicle or after having installed new belts, check tension of belts twice in first 48 hours of system operation.

PUMP DRIVE BELT TENSION ADJUSTMENT

Pump is pivot-mounted on one attaching bolt at inner side of pump, and belt tension adjustment is accomplished by means of slotted bolt hole in pump mounting bracket at outer attaching bolt (fig. 21). A 1/4 to 3/8 inch deflection, midway between pulleys on belts is satisfactory.

To make adjustment, loosen nut of pump outer attaching bolt, then using a small pry lever as shown, force pump downward to increase tension

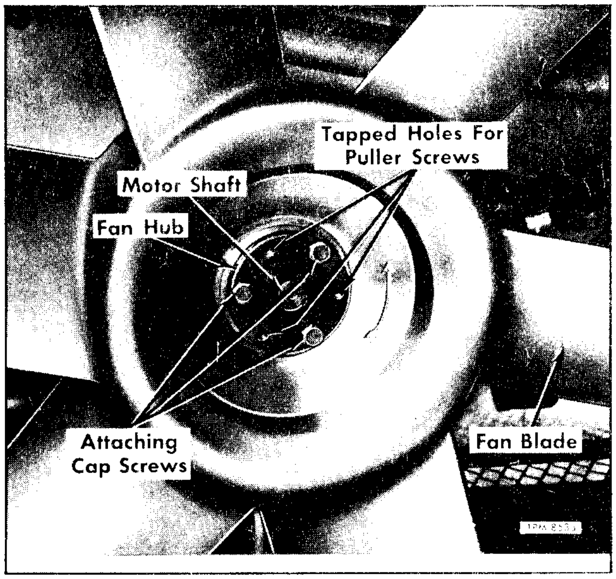


Figure 23—Condenser Fan Blade Installation

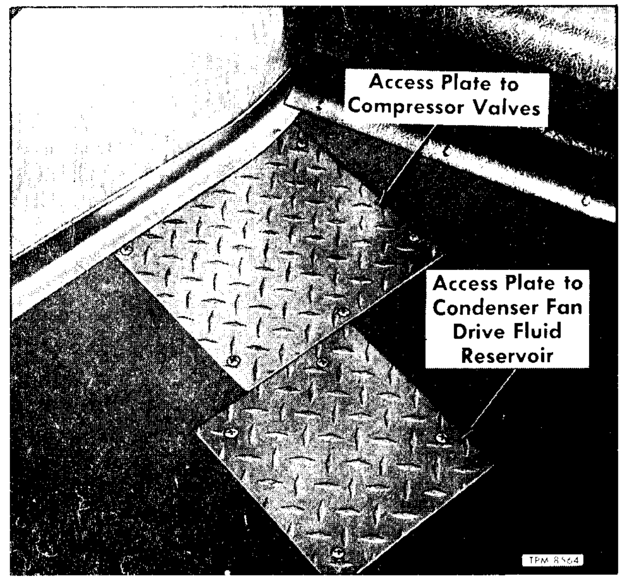


Figure 24—Access Plates over Compressor and Reservoir

on belts. Tighten both inner and outer attaching bolt nuts firmly after proper tension is obtained.

PUMP DRIVE BELT ALIGNMENT

At regular intervals pump drive belt alignment should be checked as misalignment could cause rapid wear on belts. Figure 22 shows pump mounted and means of repositioning pulley if necessary. Proper alignment exists when pump pulley belt grooves are squared with belt grooves on compressor flywheel pulley within clutch housing. This alignment can be made by moving pulley and tapered hub in or out on pump shaft. Pulley and hub are retained to shaft with three screws. Move pulley and hub on shaft as necessary, then retighten screws firmly. Also, proper alignment exists when pulley grooves are on same plane. Misalignment here could occur if the four bolts which attach pump mounting bracket to the clutch housing should loosen. Bolt holes in mounting bracket are slightly larger than bolt diameters, and loosened bolts could allow entire pump and bracket unit to shift on compressor flanges. Tighten all four bracket-to-compressor bolts firmly.

PUMP DRIVE BELT REPLACEMENT

IMPORTANT: If only one of the three drive belts fail it is essential that entire set be replaced.

In order to replace drive belts, it is necessary to first remove the clutch housing from compressor. Instructions under "Compressor Drive Clutch" with reference to "Removal and Installation" will apply.

After installing belts, adjust belt tension as explained previously under "Pump Drive Belt Tension Adjustment."

FAN BLADE REPLACEMENT

Removal

1. Unlatch fan shroud from condenser, then swing shroud inward.

2. Loosen three cap screws which secure fan blade to fan hub (fig. 23). Screws should be loosened to relieve clamping effect of fan hub on motor shaft.

3. Install three long puller screws in tapped holes of fan hub shown in figure 23, then tighten screws evenly to separate fan from hub and to force hub from motor shaft. Remove hub and fan blade.

CAUTION: Handle fan blade carefully.

Installation

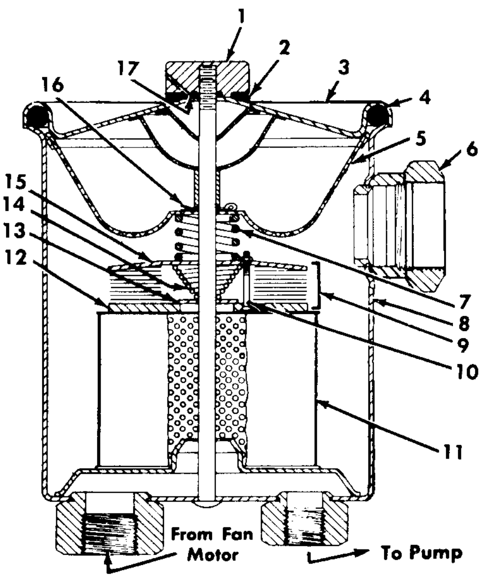
NOTE: Fan hub should be opened slightly (wedge and press) to permit installation over motor shaft.

1. Position fan blade over taper of fan hub and secure loosely with three attaching cap screws.

2. Locate drive key into keyway of motor shaft, then slowly place fan blade and hub over motor shaft and into alignment with shaft key. Push fan hub onto shaft to a position whereby the trailing edge of blade fin is flush with edge of shroud opening rim (fig. 17). Tighten three attaching cap screws alternately until tight.

CONDENSER FAN FLUID RESERVOIR

Fluid reservoir is used in the fan hydraulic drive system to retain sufficient supply of fluid in system and to filter the fluid. Reservoir is rubber-mounted and is located in the compressor com-



1 Nut
2 Nut Gasket
3 Reservoir Cover Assy.
4 Cover O-ring Seal
5 Strainer Screen
6 Sight Glass
7 Spring
8 Reservoir Housing
9 By-Pass Filter Assy.
10 Filter Screw
11 Filter Element
12 By-Pass Filter Plate
13 By-Pass Valve Disc
14 Valve Disc Spring
15 By-Pass Filter Cover
16 Cotter Pin
17 O-ring Gasket

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Figure 25—Sectional View of Fluid Reservoir (Typical)

partment (fig. 18). Figure 24 shows access plate to reservoir. Plate is secured to floor with screws. A disposable type filter element is located in bottom of reservoir (fig. 25) with a fluid by-pass filter and valve located directly on top of element. Purpose of the by-pass valve is to allow passage of fluid through reservoir in the event the filter element becomes clogged.

The system fluid and the disposable type element should be replaced annually, preferably at beginning of the operating season.

DISASSEMBLY

NOTE: Key numbers in following text refer to figure 25.

1. Remove nut (1) with gaskets (2 and 17), then lift cover (3) from reservoir housing (8). If necessary, remove cover O-ring seal (4) from cover.

2. Using thin-nose pliers as shown in figure 26, remove small cotter pin (16) which retains strainer screen (5) in housing. CAUTION: Do not poke hole in screen with pliers when cotter pin releases from thru bolt. Lift screen from housing.

3. Remove spring (7), by-pass filter assembly (9) and filter element (11) from reservoir housing.

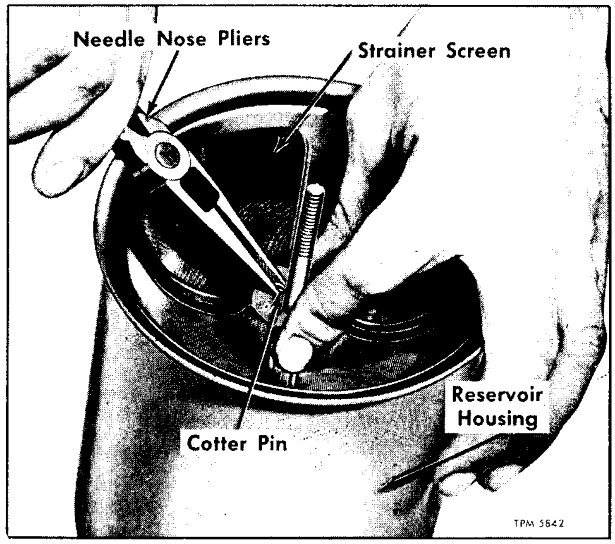


Figure 26—Method of Replacing Fluid Reservoir Screen and Cotter Pin

Discard element.

4. Disassemble by-pass filter assembly (9) by removing three filter screws (10) and nuts. Disassemble filter assembly completely.

CLEANING

Clean all removed components in cleaning solvent and allow to dry thoroughly. Using a clean lint-free cloth, swab out reservoir housing.

ASSEMBLY

NOTE: Key numbers in following text refer to figure 25.

1. Referring to figure 25 for positioning of parts, assemble by-pass filter assembly (9). Tighten filter attaching screw nuts evenly.

2. Place new filter element (11) into reservoir housing (8), then place by-pass filter assembly (9) on top of element.

IMPORTANT: Make sure filter assembly is positioned as shown. Screw nuts located top side of filter.

3. Locate spring (7) over reservoir thru bolt, then install strainer screen (5). Secure screen with cotter pin (16). NOTE: Carefully press screen down in center to permit installation of cotter pin.

4. Place O-ring seal (4) in groove of cover (3), then position cover on housing.

5. Before installing cover nut (1) and nut gaskets (2 and 17), prod small diameter wire into vent holes in cover (3) and cover nut (1). See figure 27 which shows nut removed and vent holes exposed.

6. With gasket (2) located in groove of cover nut (1), install nut.

NOTE: HAND TIGHTEN NUT, DO NOT USE WRENCH.

FAN DRIVE MOTOR REPLACEMENT

REMOVAL

1. Remove fan blade from motor as explained previously under "Fan Blade Replacement."

2. Having a clean container available, break line connections at motor; then let lines drain into container.

3. Remove bolts which attach motor to motor mounting bracket. Remove motor assembly.

INSTALLATION

1. Before installing motor, check condition of motor bracket rubber mounting insulators. If deteriorated or damaged in any way they should be replaced. Refer to figure 17 which shows mounting and proper positioning of mounting bolts.

2. Place motor assembly to mounting bracket and attach with two bolts, nuts, and washers. Make sure bolts are inserted from fan side of bracket as shown in figure 17. Tighten bolt nuts firmly.

3. Connect hydraulic lines to motor as shown in figure 16. Tighten line connections firmly.

4. Install fan blade to motor shaft as explained previously under "Fan Blade Replacement."

FAN DRIVE PUMP REPLACEMENT

REMOVAL

1. Drain condenser fan fluid system by disconnecting both fluid lines at pump. Drain fluid into clean container, then cover container. Cap ends of lines and holes in pump to prevent dirt from entering system.

2. Remove drive belts from pump pulley.

4. While supporting pump, remove four bolts which attach pump bracket to compressor housing. Remove pump with mounting bracket and pulley. Pulley and hub are attached to pump shaft with three screws. Mark pulley position (distance of pulley on shaft) in relation on shaft, then using hub screws as puller screws in tapped holes of pulley hub, remove hub and pulley with drive keys. Remove pump bracket after removing two attaching bolts and nuts.

INSTALLATION

1. Position pump bracket over pump shaft and attach to pump flange loosely with two bolts and nuts. NOTE: Make sure pump attaching bolts are inserted from pulley side of pump as shown in figure 22. Install pulley and hub with drive keys to mark made prior to removal on shaft. NOTE: If no location mark was made, position pulley 0.250" from pump seal cover as shown in figure 22. Tighten three hub screws evenly and firmly.

2. Mount pump with mounting bracket to clutch housing flange with four bolts. Tighten bolts firmly.

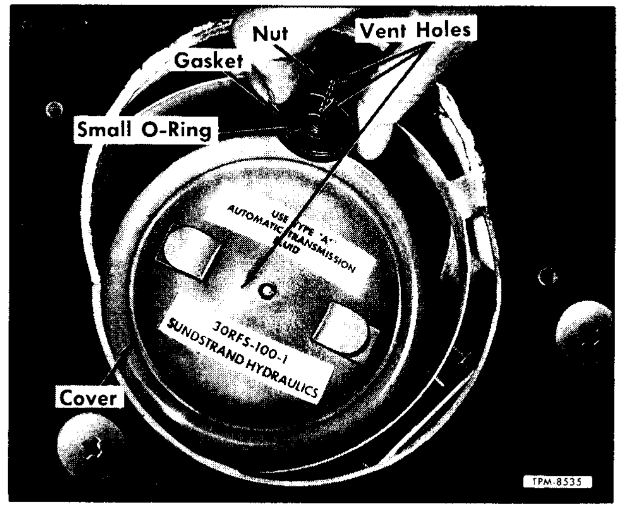


Figure 27—Vent Hole Locations in Reservoir Cover and Nut

3. Install drive belts in respective pulley grooves. Tighten belts to proper tension as instructed previously under "Fan Drive Maintenance." See "Pump Drive Belt Tension Adjustment."

4. Connect fluid lines to pump ports. Tighten connections firmly. Recheck belt alignment.

5. Fill fluid system as instructed later under "SYSTEM SERVICES AND TESTS."

FAN DRIVE PUMP OVERHAUL

NOTE: Key numbers in following text refer to figure 28.

REMOVAL

1. Remove drive key (9) from end of shaft (4).

2. Remove three screws (13) which retain seal support (22) to housing. Use a 1/8 inch hex wrench.

3. Remove large rubber seal washer (15), seal support (22), small rubber seal washer (26), and housing seal (21). These parts may be removed in assembly with pilot (8).

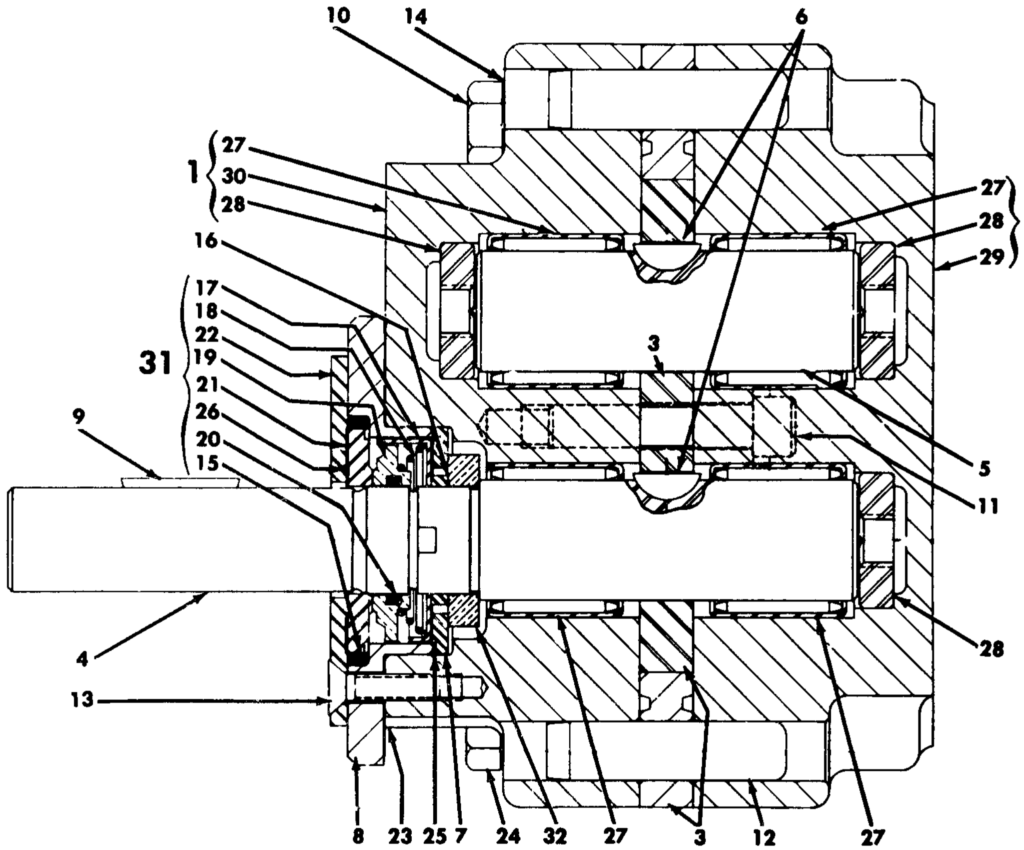
4. Remove shaft seal (19), seal spring (18) and spring retainer (17) by grasping two of the retainer prongs with needle nose pliers. Remove thrust washer (7), spring retainer spacer (16), and shims (25) (if used) from drive shaft.

5. Scribe a mark across body exterior to assure original positioning of parts when reassembled later.

6. Remove two screws (11) which attach port housing (29) to mounting housing (30).

7. Remove six cap screws (10) and two cap screws (24) which attach mounting housing to port housing.

8. Using a soft head hammer, tap alternately



1 Mounting Housing Assembly (Incl. items 27, 28, and 30)
2 Port Housing Assembly (Incl. items 27, 28, and 29)
3 Gear Spacer Plate Assembly (Incl. Gears - Pump Members)
4 Drive Shaft Assembly
5 Idler Shaft
6 Key
7 Thrust Washer
8 Pilot
9 Key
10 Hex Hd. Cap Screw (3/8-24)
11 Socket Hd. Cap Screw (5/16-18)
12 Dowel Pin
13 Flat Hd. Socket Cap Screw (10-24)
14 Lock Washer (3/8 Medium)
15 Large Rubber Seal Washer
16 Spring Retainer Spacer
17 Spring Retainer
18 Seal Spring
19 Shaft Seal
20 O-ring
21 Housing Seal
22 Seal Support
23 Pilot Gasket
24 Hex Hd. Cap Screw (3/8-24)
25 Shaft End Play Shims (As req'd. - Sizes 0.005", 0.010", and 0.015")
26 Small Rubber Seal Washer
27 Bearing (Torrington GB-1416)
28 Thrust Washer
29 Port Housing
30 Mounting Housing
31 Seal Assembly (Kit)
32 Shaft Spacer

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Figure 28—Sectional View of Fan Drive Fluid Pump

on ears of mounting housing (30) to slowly separate the pump body sections.

CAUTION: DO NOT ATTEMPT TO PRY SECTIONS APART AS DAMAGE TO SEALING SURFACES WILL OCCUR.

9. Remove idler shaft (5), drive shaft (4) gear spacer plate assembly with gears (3) and gear drive keys (6). Remove shaft spacer (32) from drive shaft.

IMPORTANT: Do not nick lapped surfaces of mounting housing (30), plate assembly (3) and port housing (29).

10. If inspection indicates that bearings (27) need be replaced, they can be pulled from recess.

NOTE: Bearings will be further damaged in the pulling process. Referring to figure 29, and using puller equipment shown, pull thrust washers (28) which will also pull the bearings (27) from housings.

11. If necessary, dowel pins (12) can be driven from attached part.

CLEANING AND INSPECTION

NOTE: Key numbers in following text refer to figure 28.

1. Wash all parts in cleaning solvent.
2. Inspect bearing and seal surfaces of shafts. Replace shaft if excessively worn or damaged.
3. Check condition of thrust washers (28) and pump gears. If sides of gears are worn excessively the plate with gears must be replaced as a unit.

ASSEMBLY

IMPORTANT: Absolutely no dirt should be permitted on any part to be assembled.

NOTE: Key numbers in following text refer to figure 28.

1. Making sure grooved side of thrust washers (28) are up, carefully drive each washer into recess. Use a wood or soft metal driver.
2. Using a suitable bearing installer, press bearings (27) into housing recess to distance shown in figure 28.
3. Insert drive shaft (4) into mounting housing (30), then press shaft spacer (32) onto shaft until it butts on shoulder of shaft.
4. Assemble drive keys (6), gear and plate assembly (3) idler shaft (5) and install into position making sure alignment marks made prior to disassembly are aligned. Install port housing (29).
5. With dowel pins positioned as shown in figure 28, drive pins to finally locate pump major units.
6. Install two cap screws (11), six cap screws (10), and two cap screws (24) securing pump components together. Final tighten all cap screws evenly and firmly.
7. Referring to figure 28 which shows position of shaft seal components, install shaft end play shims (25) if used, spring retainer spacer (16) and thrust washer (7).
8. Install spring retainer (17) over shaft and rotate until it drops in place on two flats of shaft.
9. Insert seal spring (18) into recess. Make sure large end of spring is inserted first.
10. Install small O-ring (20) into internal groove of shaft seal (19). Grease O-ring surfaces.
11. Carefully lower shaft seal (19) with installed O-ring (20) and register small end of seal spring (18) over hub. Make sure sealing surface of shaft seal (19) is located outward. Position shaft seal (19) with three slots to match three prongs on spring retainer (17). Compression of spring will be accomplished in final assembly.
12. Install large rubber seal washer (15) into pilot (8) and press housing seal (21) into pilot assembly. Be sure sealing surface of housing seal (21) is installed in the downward position to match sealing surface on shaft seal (19). Large rubber seal washer should be pressed down uniformly and flush with face of pilot (8). Outward face of housing seal (21) should be positioned approximately 1/32 inch above face of pilot (8).
13. Insert small rubber seal washer (26) into recess of seal support (22) and position seal support (22) with seal washer in assembly on pilot (8). Index three screw holes in seal support (22) to match three holes in pilot (8).
14. Check pilot gasket (23) and replace if damaged. Place gasket (23) on flange of pilot (8), making sure three holes line up. Place pilot (8) and seal support (22) on shaft. Align screw holes and three prongs of spring retainer (17) to see that they match.
15. Press pilot (8) into mounting housing (30) and tighten three attaching screws evenly and firmly.

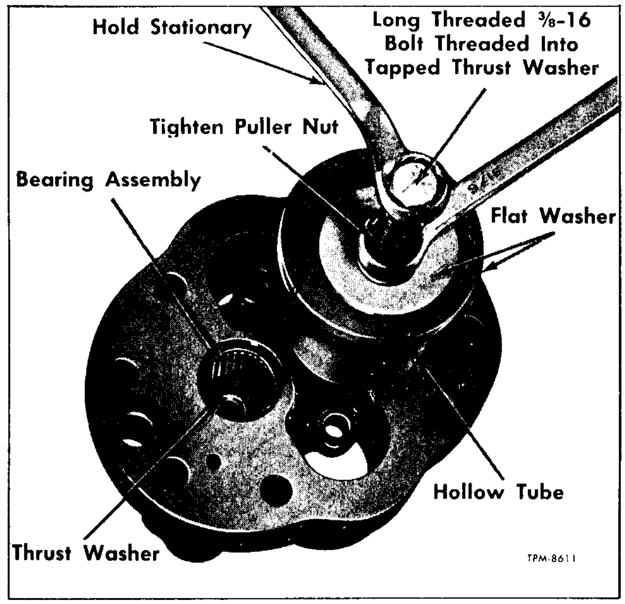


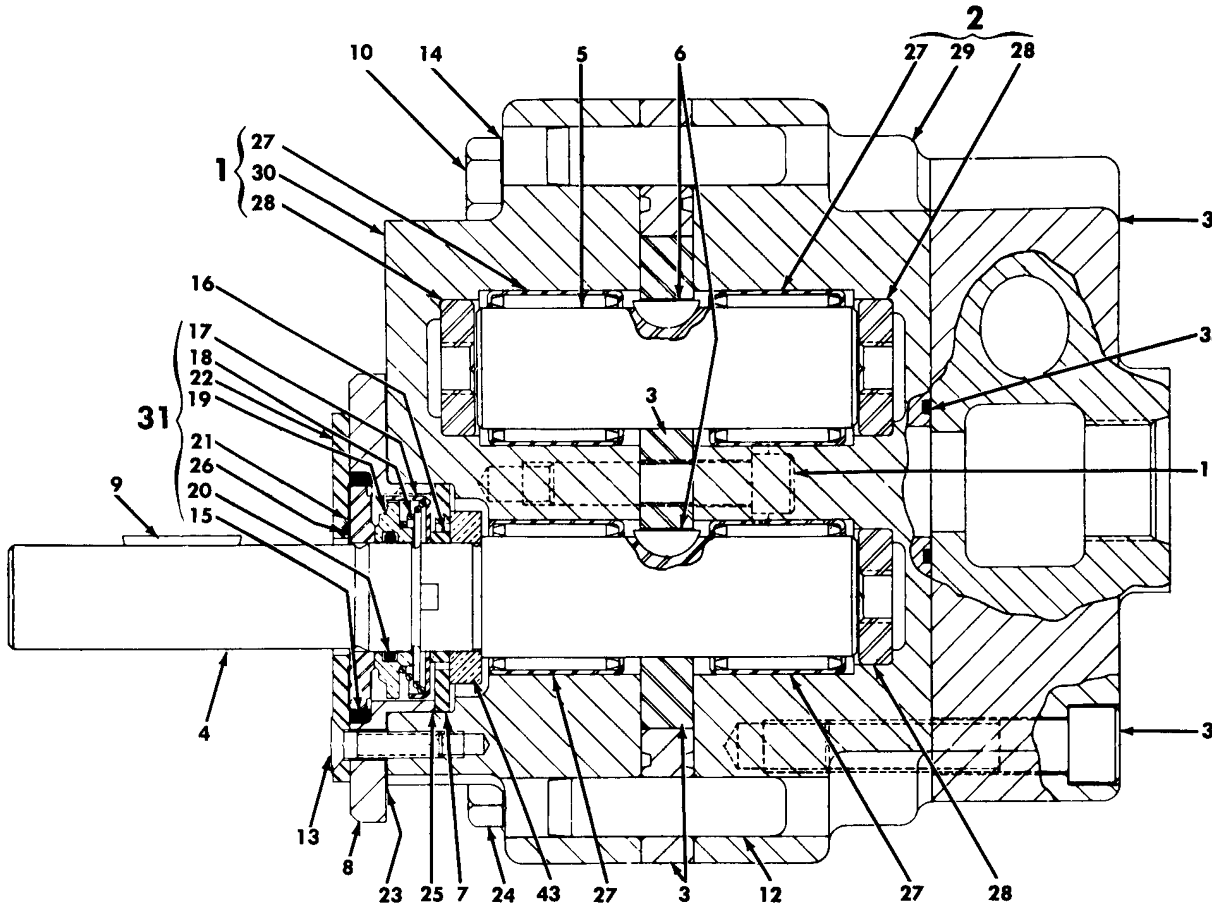
Figure 29—Method of Pulling Thrust Washer and Shaft Bushing

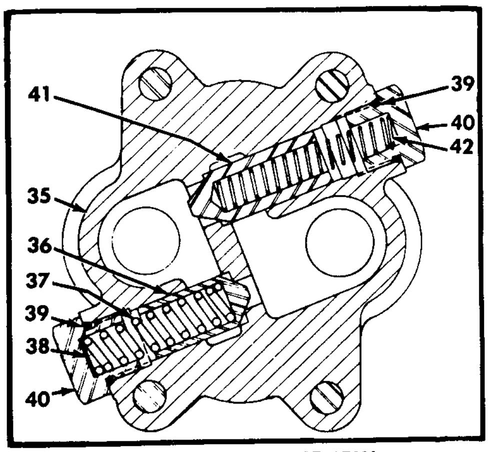
FAN DRIVE MOTOR OVERHAUL

NOTE: Key numbers in following text refer to figure 30.

REMOVAL

1. Remove drive key (9) from end of shaft (4).
2. Remove three screws (13) which retain seal support (22) to housing. Use a 1/8 inch hex wrench.
3. Remove large rubber seal washer (15), seal support (22), small rubber seal washer (26), and housing seal (21). These parts may be removed in assembly with pilot (8).
4. Remove shaft seal (19), seal spring (18) and spring retainer (17) by grasping two of the retainer prongs with needle nose pliers. Remove thrust





VALVE BLOCK ASSEMBLY

1 Mounting Housing Assembly (Incl. items 27, 28, and 30)
2 Port Housing Assembly (Incl. items 27, 28, and 29)
3 Gear Spacer Plate Assembly (Incl. Gear Members)
4 Drive Shaft Assembly
5 Idler Shaft
6 Key
7 Thrust Washer
8 Pilot
9 Key
10 Hex Hd. Cap Screw (3/8-24)
11 Socket Hd. Cap Screw (5/16-18)
12 Dowel Pin
13 Flat Hd. Socket Cap Screw (10-24)
14 Lock Washer (3/8 Med.)
15 Large Rubber Seal Washer
16 Spring Retainer Spacer
17 Spring Retainer
18 Seal Spring
19 Shaft Seal
20 O-ring
21 Housing Seal
22 Seal Support
23 Pilot Gasket
24 Hex Hd. Cap Screw (3/8-24)
25 Shaft End Play Shims (As req'd. - Size 0.005", 0.010", and 0.015")
26 Small Rubber Seal Washer
27 Bearing (Torrington GB-1416)
28 Thrust Washer
29 Port Housing
30 Mounting Housing
31 Seal Assembly (Kit)
32 Valve Block Assembly
33 O-ring
34 Socket Hd. Cap Screw
35 Valve Block Housing
36 Relief Valve Piston
37 Relief Valve Spring
38 Shims - as required
39 O-ring
40 Valve Block Plug
41 Over-running Valve Piston
42 Over-running Valve Spring
43 Shaft Spacer TPM-8570

Figure 30—Sectional View of Condenser Fan Drive Fluid Motor

washer (7), spring retainer spacer (16), and shims (25) (if used) from drive shaft.

5. Scribe a mark across body exterior to assure original positioning of parts later.

6. Remove four cap screws (34) which attach valve block assembly (32) to motor. Remove block and O-ring (33).

7. Remove two screws (11) which attach port housing (29) to mounting housing (30).

8. Remove six cap screws (10) and two cap screws (24) which attach mounting housing.

9. Using a soft head hammer, tap alternately on ears of mounting housing (30) to slowly separate the pump body sections.

CAUTION: DO NOT ATTEMPT TO PRY SECTIONS APART AS DAMAGE TO SEALING SURFACES WILL OCCUR.

10. Remove idler shaft (5), drive shaft (4) gear spacer plate assembly with gears (3) and gear drive keys (6). Remove shaft spacer (43).

IMPORTANT: Do not nick lapped surfaces of mounting housing (30), plate assembly (3) and port housing (29).

11. If inspection indicates that bearings (27) need be replaced, they can be pulled from recess.

NOTE: Bearings will be further damaged in the pulling process. Referring to figure 29, and using puller equipment shown, pull thrust washers (28) which will also pull the bearings (27) from housings.

12. If necessary, remove dowel pins (12).

13. Remove plugs (40), O-rings (39), springs (37 and 42), and pistons (36 and 41) from valve block (32). Be careful not to loose shims (38) between relief valve spring (37) and hex plug.

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 30.

1. Wash all parts in cleaning solvent.

2. Inspect bearing and seal surfaces of shafts. Replace shaft if excessively worn or damaged.

3. Check condition of thrust washers (28) and pump gears. If sides of gears are worn excessively the plate with gears must be replaced as a unit.

4. Examine surfaces of relief valve piston (36) and over-running valve piston (41).

5. Air pressure into openings of motor components will remove any loose particles of dirt.

ASSEMBLY

IMPORTANT: Absolutely no dirt should be permitted on any part to be assembled.

NOTE: Key numbers in text refer to figure 30.

1. Making sure grooved side of thrust washers (28) are up, carefully drive each washer into recess. Use a wood or soft metal driver.

2. Using a suitable bearing installer, press bearings (27) into housing recess to distance shown.

3. Insert drive shaft (4) into mounting housing (30), then press shaft spacer (43) onto shaft until it butts on shoulder of shaft.

4. Assemble drive keys (6), gear and plate assembly (3) idler shaft (5) and install into position making sure alignment marks made prior to disassembly are aligned. Install port housing (29).

5. With dowel pins positioned as shown in figure 30, drive pins to locate pump major units.

6. Install two cap screws (11), six cap screws (10), and two cap screws (24) securing pump components together. Final tighten all cap screws.

7. Referring to sectional view of valve block (fig. 30), install relief valve piston (36), spring (37), shims (38), O-ring (39) and plug (40) into valve block as shown. At other port, install over-running valve piston (41), piston spring (42), O-ring (39) and plug (40) into valve block as shown. With O-ring (33) located in port housing groove, install valve block assembly (32) to port housing with four cap screws (34). Tighten cap screws evenly and firmly.

8. Referring to figure 30 which shows position of shaft seal components, install shaft end play shims (25) if used, spring retainer spacer (16) and thrust washer (7).

NOTE: At this time relief valve setting within valve block can be checked by installing a flat surface plate and gasket to motor side of block, then with a pressure gauge installed into special oil pressure supply line, apply pressure to block inlet part. Note pressure reading when relief valve opens. Relief valve should open at 1500 psi.

9. Install spring retainer (17) over shaft and rotate it slowly until it drops into place on two flats of shaft.

10. Insert seal spring (18) into recess. Make sure large end of spring is inserted first.

11. Install small O-ring (20) into internal groove of shaft seal (19). Grease O-ring surfaces.

12. Carefully lower shaft seal (19) with installed O-ring (20) and register small end of seal spring (18) over hub. Make sure sealing surface of shaft seal (19) is located outward. Position shaft seal (19) with three slots to match three prongs on spring retainer (17). Compression of spring will be accomplished in final assembly.

13. Install large rubber seal washer (15) into pilot (8) and press housing seal (21) into pilot assembly. Be sure sealing surface of housing seal (21) is installed in the downward position to match sealing surface on shaft seal (19). Large rubber seal washer should be pressed down uniformly and flush with face of pilot (8). Outward face of housing seal (21) should be positioned approximately 1/32 inch above face of pilot (8).

14. Insert small rubber seal washer (26) into recess of seal support (22) and position seal support (22) with seal washer in assembly on pilot (8). Index three screw holes in seal support (22) to

match three holes in pilot (8).

15. Check pilot gasket (23) and replace if damaged. Place gasket (23) on flange of pilot (8), making sure three holes line up. Place pilot (8) and seal support (22) on shaft. Align screw holes and three prongs of spring retainer (17) to see that they match.

16. Press pilot (8) into mounting housing (30) and tighten three attaching screws evenly and firmly.

REFRIGERANT COMPRESSOR

The refrigerant compressor (fig. 40) is a three-cylinder reciprocating type unit. It is self-lubricated and self-contained. The shaft seal is rotary type, consisting of a stationary lapped seal face ring pressed into the seal cover plate, with a spring-loaded rotating carbon nose ring working against the seal face of the stationary ring. A Neoprene seal ring between the carbon nose ring and spring acts as a seal around the shaft. The seal faces are flood-oiled under pressure at all times. A sight glass on the side of the compressor shows the oil level. Shut-off valves are provided at the compressor suction and discharge ports.

Compressor can be removed separately from the coach compartment or it can be removed with the engine as a unit. Figure 31 shows refrigerant compressor and clutch installed. These removal procedures are explained later under "Compressor Replacement." Overhaul instructions of compressor are also explained later under "Refrigerant Compressor Overhaul."

COMPRESSOR OPERATION

NOTE: Figure 40 shown later under "Refrigerant Compressor Overhaul" shows sectional view of compressor.

The aluminum body of the compressor is divided into three main sections -- the discharge or high pressure gas cavity, the suction or low pressure gas cavity, and the crankcase.

Low pressure refrigerant gas is drawn into the compressor from the suction line. As the refrigerant gas enters the compressor it passes through fine mesh strainer screens and then into the suction cavity. In the suction cavity, oil entrained with the refrigerant separates from the refrigerant and passes into the crankcase through a check valve. The low pressure refrigerant is drawn into the cylinder during the down-stroke of the piston through the cylinder suction valve which is mounted on the top of the cylinder liner. During the suction stroke of the piston, the cylinder discharge valve in cage on top of cylinder liner is

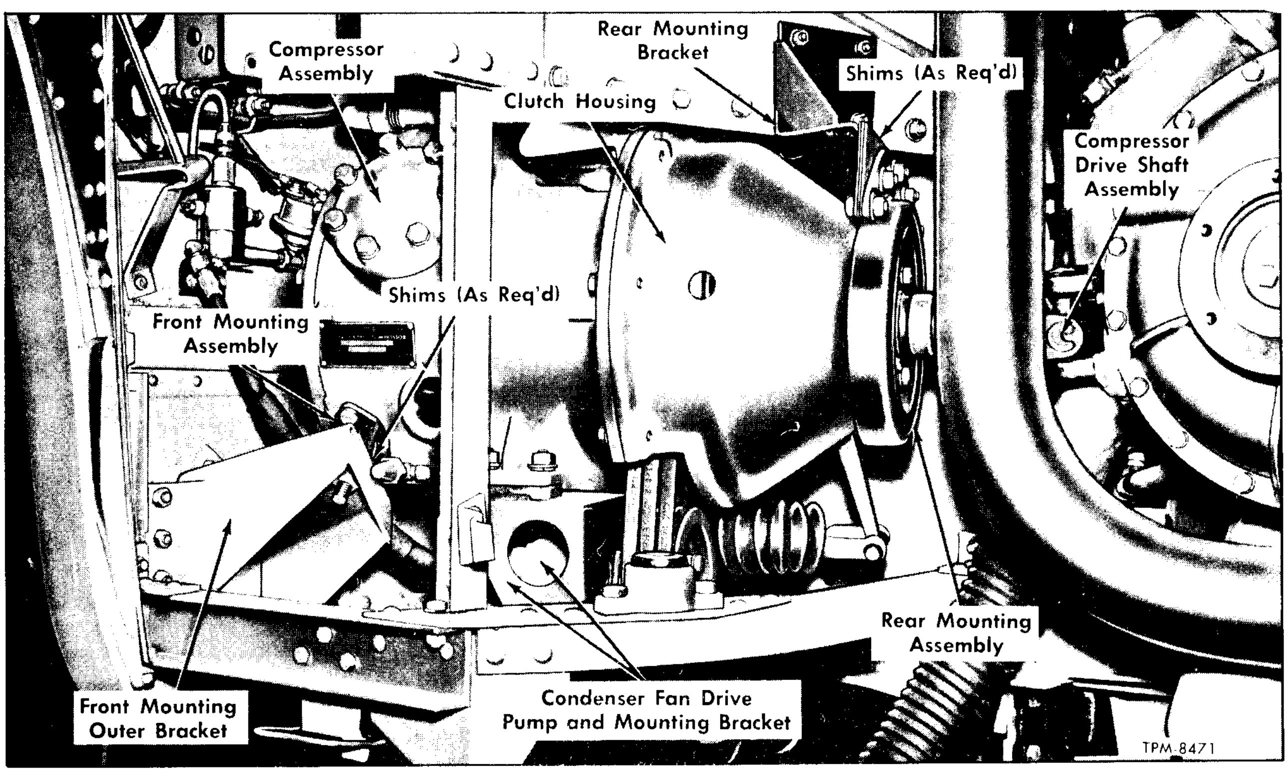


Figure 31—Compressor and Clutch Assembly Installed (Radiator Removed)

closed. As the piston begins its compression stroke, the cylinder suction valve closes and compression begins. As the piston moves up on the compression stroke, the cylinder discharge valve opens, and the high pressure refrigerant gas passes through the valve into the discharge cavity. The gas then passes through the discharge cavity to the high pressure refrigerant line. A spring-loaded safety relief valve is mounted in the wall which divides the high and low sides of the compressor. This valve serves to relieve or bypass discharge pressure to the low side of the compressor should the discharge pressure build up normally high or above the set point of the high to low relief valve. Such a condition would occur if the compressor was operated with the discharge line shut-off valve closed.

COMPRESSOR MAINTENANCE

Compressor requires practically no maintenance other than making sure that sufficient (but not too much) oil and refrigerant is maintained in the system at all times. The lubrication system of the compressor will fail if the system loses its charge of oil or refrigerant. Both oil and refrigerant must be circulating through the compressor whenever it is running to prevent very serious damage. Check compressor mounting bolts periodically. Check carefully for indication of oil or refrigerant leakage. Leaks should be remedied promptly to prevent excessive refrigerant and oil loss. If necessary, compressor can be overhauled as explained later under "Refrigerant Compressor Overhaul."

COMPRESSOR LUBRICATION

The compressor crankcase serves as a reservoir for the main oil charge. A portion of the lubricating oil circulates with the refrigerant, and this oil is separated from the refrigerant as the refrigerant passes through the suction cavity of the compressor. As the low pressure refrigerant and oil separate in the suction chamber, the oil goes to the bottom of the chamber, and the gas goes to the top of the chamber. The oil passes from the suction chamber to the crankcase through a check valve in the crankcase wall. This check valve allows oil to flow into the crankcase from the suction cavity, but checks against the flow of oil out of the crankcase.

During the "OFF" cycle of the compressor, refrigerant tends to collect and condense in the crankcase. The liquid refrigerant mixes with the oil in the crankcase. When the compressor begins to operate, there is a rapid reduction of pressure in the crankcase above the oil level. This permits the liquid refrigerant to evaporate out of the oil. As the refrigerant boils off and leaves the crankcase, the oil tends to foam and leave with the refrigerant. To prevent serious loss of crankcase oil

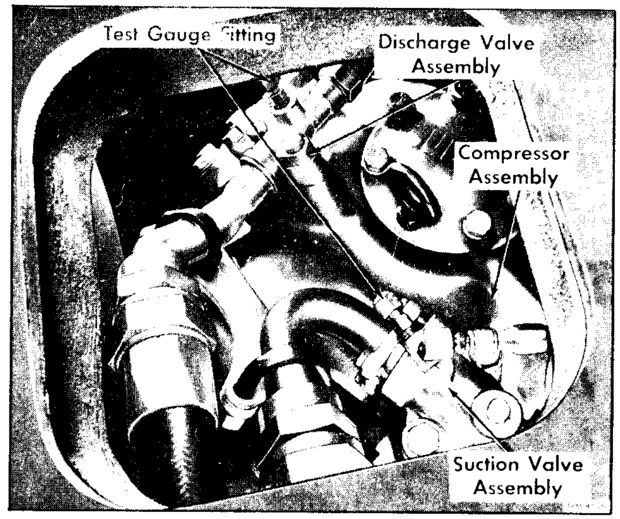


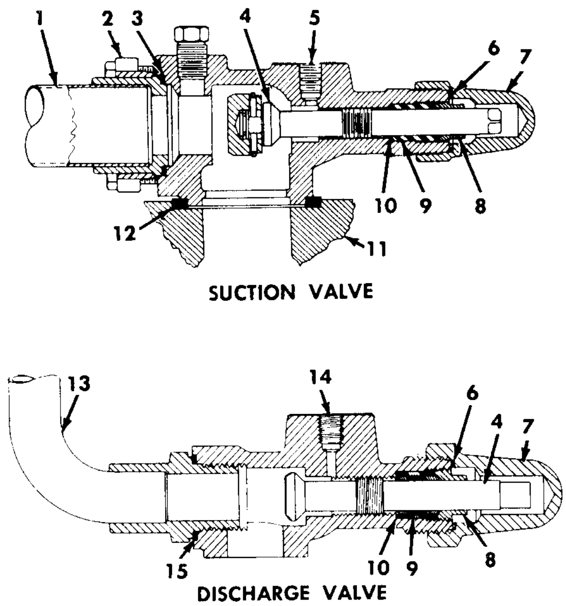
Figure 32—Access Opening to Compressor Valves

on start-up, the refrigerant leaving the crankcase passes through a fine bronze screen or foam breaker. The foam breaker separates the oil from the refrigerant and returns the oil through a passage to the crankcase.

Compressor lubrication is accomplished by a force feed, direct drive, positive displacement pump, which is mounted at the end of the crankshaft. Oil from the crankcase is drawn into the pump through a tube which connects the pump to a fine mesh strainer located in the sump of the crankcase. This strainer scavenges oil from the bottom of the crankcase and prevents the entrance of foreign particles into the oil circulating system.

The pump forces oil through the discharge tube and into a cavity below the bearing head assembly. A passageway in the bearing head lines up with the oil cavity below the bearing head. Oil travels from the cavity through the passageway to the main bearing. There are additional passages in the bearing head which conduct oil from the passageway to the crankshaft small bearing and to the shaft seal chamber. Oil enters the shaft seal chamber through an orifice plug in the bearing head. An oil passage in the crankshaft carries oil under pressure from the large bearing to the three connecting rods. Lubrication of the cylinder walls and the piston pins is accomplished by the oil mist in the crankcase. Each connecting rod has a small cup and hole at the top of the rod above the piston pin. Oil from the crankcase travels down through this hole to lubricate the piston pin.

It is highly important that only the recommended refrigeration compressor oils which contain a de-foamant be used in this compressor. The approved oils for use in this compressor are listed in "AIR CONDITIONING LUBRICATION AND INSPECTION" later in this group. These oils can be



1 Refrigerant Line (To Heat Exchanger)	9 Packing
2 Flange Ring	10 Packing Washer
3 Gasket	11 Compressor Housing
4 Valve and Stem Assembly	12 Gasket (To Compressor Housing)
5 Line Port (To Test Gauge Fitting and Hi-Lo Switch)	13 Refrigerant Line (To Condenser Coil)
6 Cap Gasket	14 Line Port (To Test Gauge Fitting and Hi-Lo Switch)
7 Cap	
8 Packing Nut	15 Silver Solder TPM-8467

Figure 33—Compressor Refrigerant Valves

obtained locally through refrigeration equipment suppliers. Oil should be purchased in sealed cans only. Never use bulk oil or oil which has been exposed to air.

IMPORTANT: USE ONLY APPROVED COMPRESSOR OILS.

The initial charge of oil in the compressor is 4 pints. After the compressor has been operated for about 30 minutes, the oil level should be about 1/3 to 1/2 of the way up on the compressor sight glass. If oil is near or below the bottom of the sight glass, oil should be added. The oil level should always be checked with the compressor operating. Before adding oil, first determine and correct cause of loss of oil.

A new compressor or one having been overhauled should be drained and refilled after the first 200 hours of operation. Refer to "SYSTEM SERVICES AND TESTS" for adding and draining of compressor oil.

COMPRESSOR SHUT-OFF VALVES

Double-seating shut-off valves are provided at the compressor discharge and suction ports. Valves are accessible from compressor compartment or through an access opening in floor (figs. 24 and 32). With both valve stems turned all the way in (closed), compressor is isolated from the rest of the system. Stems of both valves must be turned all the way out to the back-seated (fully open) position whenever lines to "HI-LO" pressure cut-out switch are disconnected. "Operating Position" of valves, frequently referred to in this section is with the valve stem cracked 1/2 to 1 turn from the back-seated position as shown in figure 33, to admit system pressures into the gauge and "HI-LO" pressure cut-out switch tee fittings.

IMPORTANT: Valve caps with gaskets must be in place and tight at all times during system operation.

COMPRESSOR STORAGE

1. If compressor is to remain inoperative in coach for an extended period, a very small amount of refrigerant may be lost through the shaft seal, because the shaft seal did not remain wetted. To prevent loss of refrigerant through the shaft seal, the compressor, suction, and discharge service valves should be closed (front seated. This will isolate the compressor from the rest of the system. Another method of preventing loss of refrigerant through the compressor shaft seal when the compressor is idle for a long period of time, is to operate it for every four or five days (outside temperatures permitting). This will maintain a film of oil on the sealing surfaces of the seal and on the bearings.

2. If compressor is removed from coach and is to remain in storage, stand the compressor on end, drive end down, on blocks in such a way that no weight rests on the compressor shaft.

COMPRESSOR REPLACEMENT

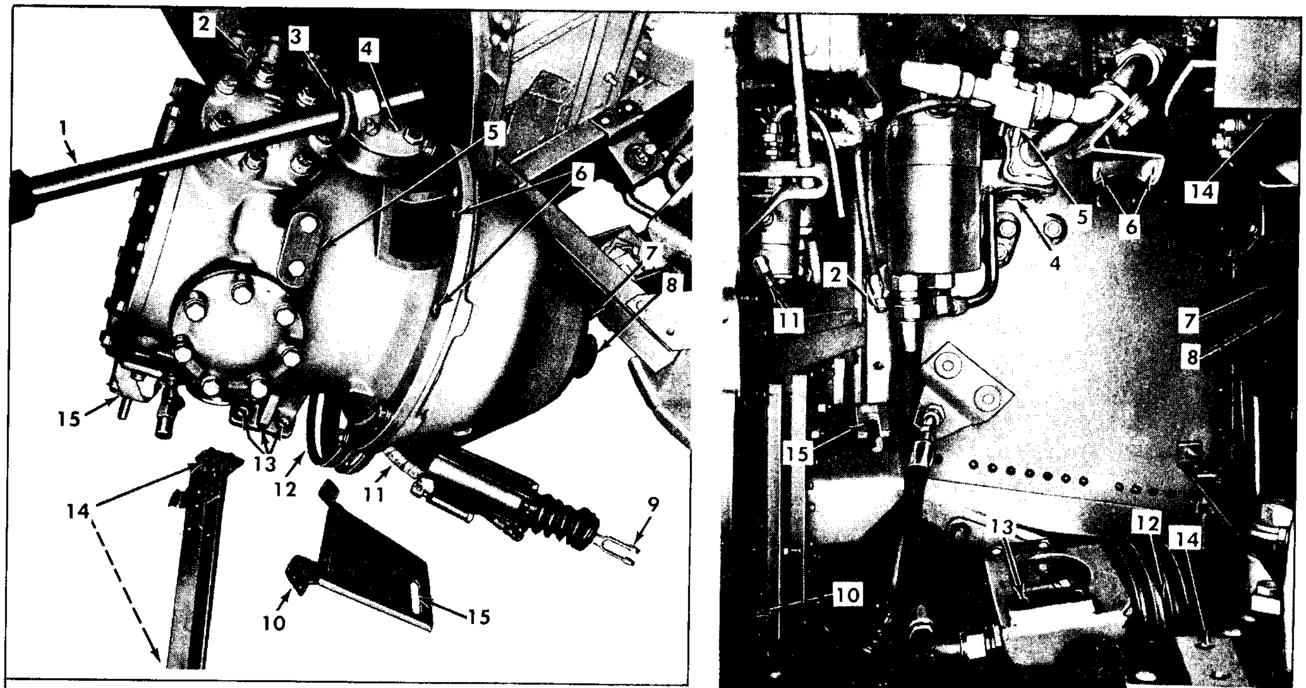
NOTE: Compressor which can be readily removed from compressor compartment is removed with the clutch assembly attached. Before removing compressor, pump down the system as directed later under "Pumping Down the System." It is not necessary to disconnect hydraulic fluid lines from condenser fan pump to replace the compressor or the clutch.

IMPORTANT: Before disconnecting compressor obtain closure plate to install over valve ports. See figure 35.

COMPRESSOR REMOVAL

NOTE: Key numbers in text refer to figure 34.

1. Position rear wheels of coach on four to six inch run-up blocks. This is not absolutely necessary, but it will allow easier access for making



DISCONNECT POINTS AT COMPRESSOR

DISCONNECT POINTS IN COMPARTMENT

1 Hoist Bar
2 High Pressure Line to HI-LO Pressure Switch
3 Lifting Eye
4 Suction Valve Connection
5 Discharge Valve Connection
6 Refrigerant Lines Bracket-to-Clutch Housing Connection
7 Clutch Housing to Rear Mounting Connection
8 Drive Shaft Connection
9 Air Cylinder to Release Fork Connection
10 Compressor Front Outer Mounting Bracket Connection
11 Air Cylinder Air Line Connection
12 Fluid Pump Pulley and Drive Belts
13 Fluid Pump Mounting Bracket Connection
14 Body Post Connections
15 Compressor Front Mounting Connection

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Figure 34—Compressor and Clutch Assembly Disconnect Points

lower disconnections.

2. Remove stone shield from below compressor.

3. Disconnect clutch control cylinder air line (11), then temporarily apply shop air pressure (65 psi or more) to cylinder. Remove cylinder push rod (9) yoke pin from yoke and clutch release fork. Remove air cylinder from compressor.

4. At condenser fan drive pump, loosen bolts which retain drive belt tension. Release belt tension, then remove belts from pump pulley grooves.

5. Remove four bolts which attach condenser fan drive pump bracket (13) to compressor housing. Tie pump with attached mounting bracket and lines back up under coach.

6. Remove access hole cover in floor directly above compressor (fig. 24). Through hole in floor disconnect high pressure hose to HI-LO pressure switch at compressor fitting (2). Cap the connections.

7. Remove two bolts (4 and 5) which attach discharge and suction valves to compressor.

8. Remove bolts (6) which attach refrigerant hose bracket to clutch housing.

9. Being careful not to drop dirt into valve ports of compressor, tie up suction and discharge valves with attached hoses to a bar placed across access hole above compressor. Immediately place closure plates with gaskets over open valve ports of compressor.

NOTE: Closure plates can be improvised locally. Figure 35 shows dimensions of plates.

10. Remove two bolts which attach upper and lower ends of body post (14) to body at rear of compressor. Remove post.

11. Using boom-type hoist with lifting bar (1) engaged into compressor lifting eye (3), temporarily support weight of compressor.

12. Remove nut from compressor front mounting brackets (15), then note and record the number of shims at each mounting.

13. Remove eight bolts which attach compressor front outer mounting bracket to bulkhead (10). Remove bracket.

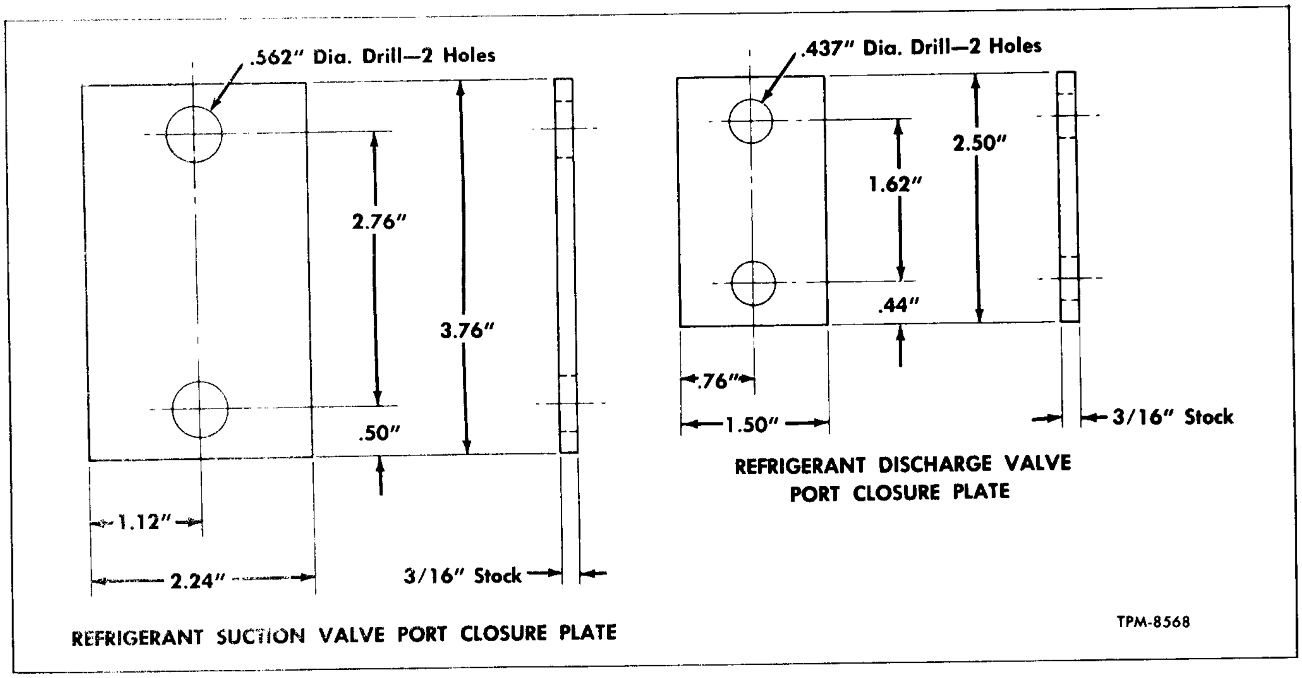


Figure 35—Compressor Valve Port Closure Plates

14. Remove four bolts (7) which attach compressor to compressor rear mounting bracket inner ring. NOTE: When compressor is moved from compartment, drive shaft yoke (8) will separate from splined clutch shaft.

15. Carefully remove compressor and clutch assembly from compartment. Support compressor in manner whereby weight is not supported on clutch release fork.

COMPRESSOR INSTALLATION

NOTE: Key numbers in following text refer to figure 34.

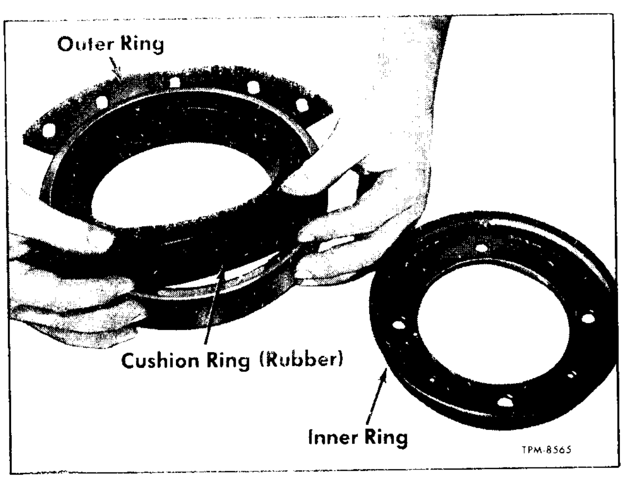


Figure 36—Replacing Compressor Rear Mounting Rubber Ring

1. Before installing compressor, examine compressor front and rear rubber mountings. If mounting rubber sections are deteriorated, or collapsed they should be replaced. Referring to figure 36, compressor rear mounting rubber ring can be replaced in manner shown. Replacement of ring can be performed with outer steel ring installed.

2. Build up compressor unit to stage shown in Left View of figure 34.

3. Place compressor unit into compartment, and at same time engage drive shaft yoke (8) over splines of compressor clutch shaft.

4. Install four bolts (7) which attach clutch housing to compressor rear mounting bracket inner ring.

5. With sealing compound applied to contact surface of compressor front outer mounting bracket (10), attach bracket to body bulkhead. Tighten attaching bolts firmly.

6. Install nuts loosely attaching compressor front rubber mountings (15) to mounting brackets. Make sure same number of shims are inserted between mounting cushion and bracket each side of compressor, then tighten mounting nuts to 30 to 40 foot-pounds torque.

7. IMPORTANT: It is necessary to align compressor with drive line if any part was replaced which would affect the original factory alignment. Replaced parts, such as any one of the three compressor mountings or the unknown number of original mounting shims, could affect alignment. It is also recommended that alignment be checked at this time regardless as to whether any mounting

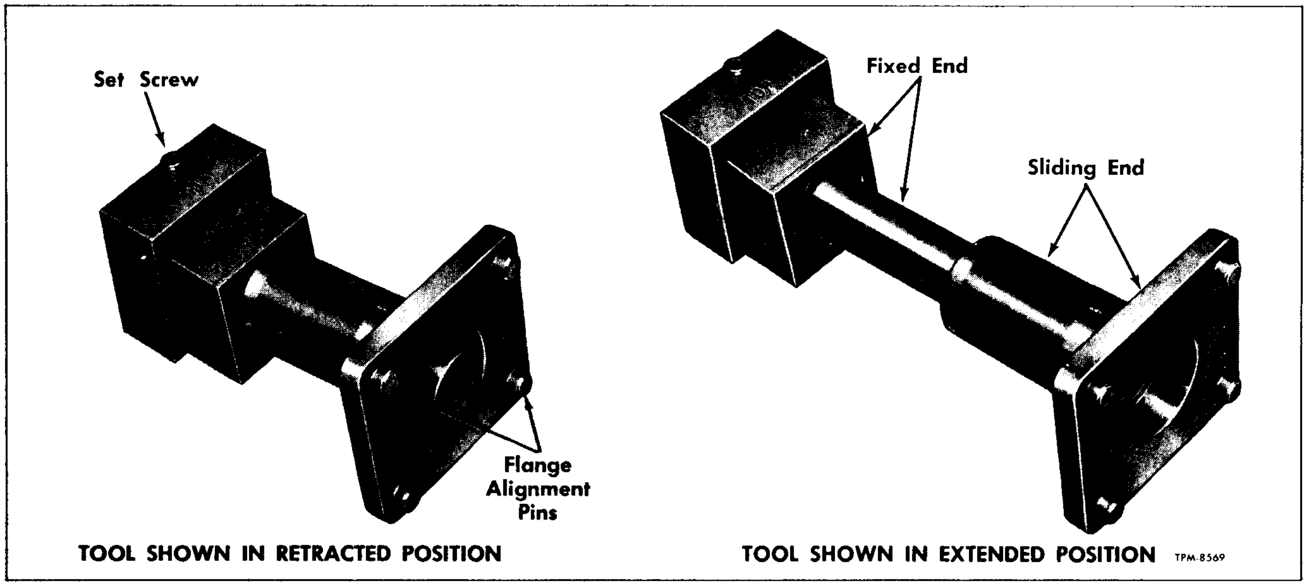


Figure 37—Compressor-to-Engine Alignment Tool

part was replaced. An alignment tool (fig. 37) can be fabricated and used to make alignment.

Tool consists of two telescopic parts which when installed on splines of clutch shaft, then extended freely to center on engine angle drive flange, will provide the necessary alignment check. Tool can be improvised locally. Figure 38 shows the dimensions and other necessary specifications of tool. Design of tool is to provide accurate check of compressor-to-angle drive angles shown in Lower View of figure 39.

8. To check existing alignment, place end of tool having a set screw over splines of compressor clutch shaft. See figure 39. Tighten set screw, then rotate shaft UNTIL TOOL SET SCREW IS LOCATED AT THE TOP. Without rotating clutch shaft, extend free end of tool and if necessary, rotate this end so that tool pins can be inserted or engaged into engine drive flange bolt holes. If it is impossible to engage pins, the compressor will have to be repositioned on one or all three of its mountings.

9. To align compressor, loosen five bolts which attach compressor drive end mounting bracket to bulkhead and loosen nuts from compressor front mounting assemblies.

10. Install special tool and check alignment as instructed in Step 8 previously.

11. Place a jack under compressor drive end mounting ring as shown in Right View of figure 39 to support this end into alignment. NOTE: A pry bar used in such a manner as to not damage parts can be used for shifting compressor as desired.

12. At front end of compressor, add or remove shims between mounting cushion and mounting bracket (Left View, fig. 39) to obtain proper alignment.

NOTE: Both the compressor front and rear mountings can be shifted a limited amount, by means of slotted holes in mounting brackets.

13. Shift the compressor assembly as necessary to obtain proper alignment. When compressor is aligned, tighten all mounting bolts. Tighten compressor front mounting nuts to 30 to 40 foot-pounds torque and tighten rear mounting bracket bolts to 20 to 25 foot-pounds torque. NOTE: If a jack was used under coach, remove jack.

14. Install body post (14) to side of coach. Tighten bolts firmly.

15. Remove closure plates (4 and 5) from ports of compressor. Being careful not to allow dirt to enter ports, attach refrigerant valves to compressor, using new gaskets. Tighten attaching bolts evenly and firmly.

16. Attach refrigerant line bracket (6) to clutch housing with two bolts.

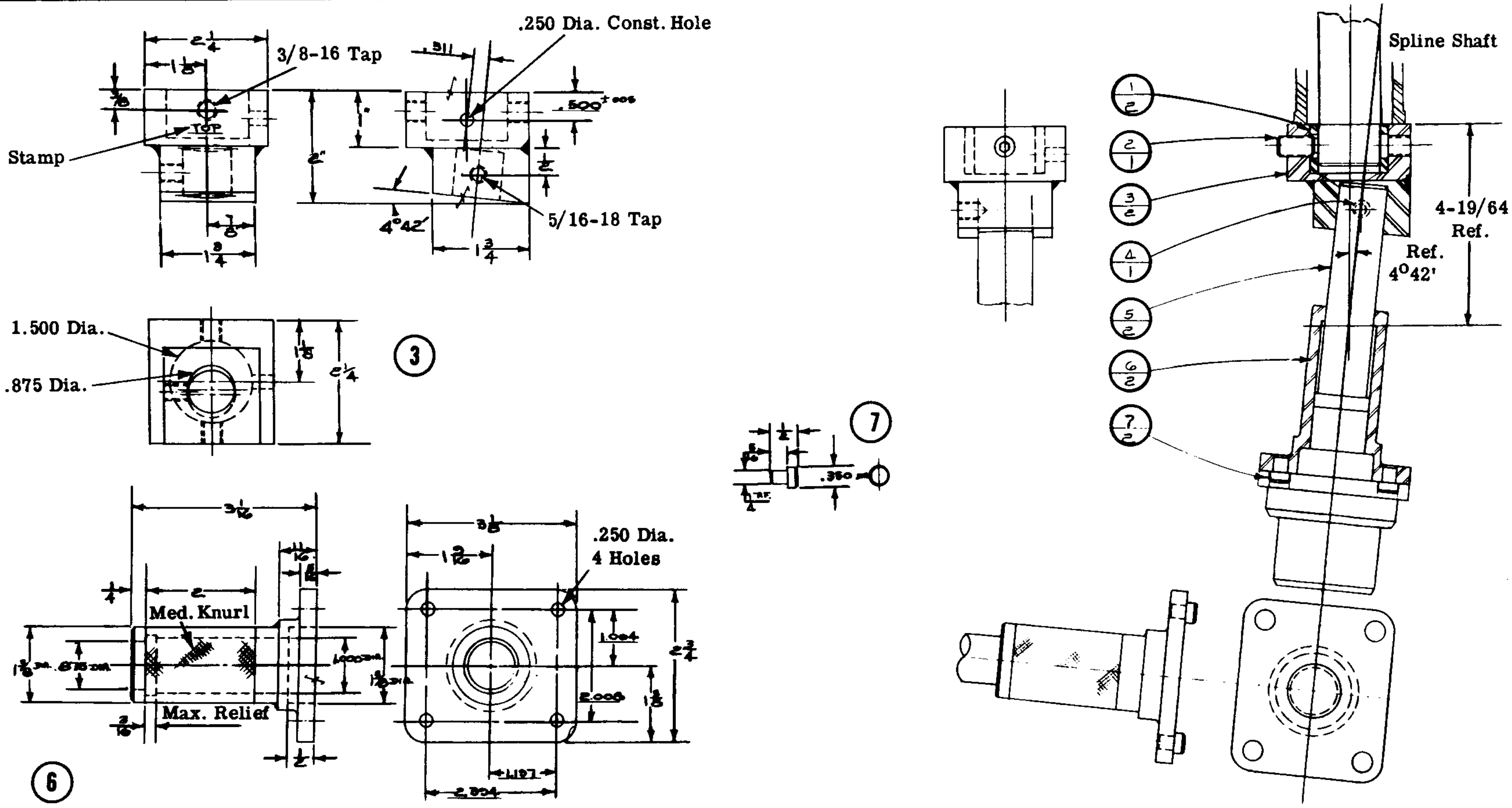
17. Connect HI-LO pressure line to compressor fitting (2). Tighten connection firmly.

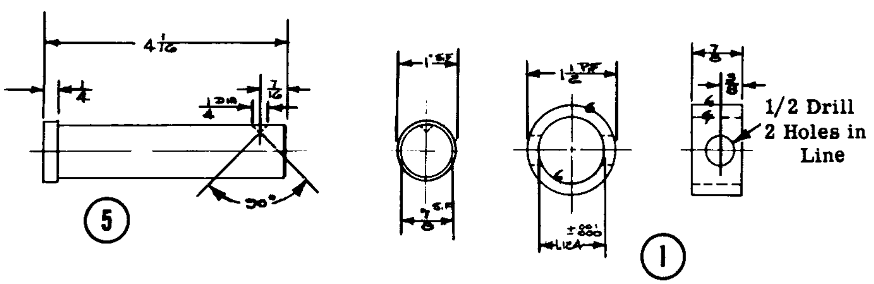
18. Install access hole covering in floor above compressor.

19. Attach condenser fan drive pump and bracket (13) to bottom of compressor housing.

20. Engage three drive belts, each in respective groove of pump pulley. Adjust belt tension as explained previously under "Fan Drive Maintenance." See "Pump Belt Tension Adjustment."

21. Install clutch control air cylinder at pivot mounting. Temporarily apply shop air pressure (65 psi or more) to clutch control air cylinder. Make clutch linkage adjustment and secure release fork to cylinder push rod yoke as directed later under "Compressor Drive Maintenance." See "Compressor Clutch Release Fork Adjustment."





Det. No.	Amt. Reqd.	Stock Size	Material
1	1	Aerocase and Gr. - 1-3/16 Dia. x 1"	C.R.S.
2	1	Dog Pt. Set Scr. - 3/8-16 x 3/4"	Std.
3	1	Weld Const. - (a) 1 Pc. 2-1/4 x 2-1/4 x 1-1/8" (b) 1 Pc. 1-3/4 x 1-3/4 x 1-1/8"	C.R.S. C.R.S.
4	1	Cone Pt. Set Scr. - 5/16-18 x 1/2	Std.
5	1	Aerocase - 1" Dia. x 4-3/16"	C.R.S.
6	1	Weld Const. - (a) 1 Pc. 3/4 x 3 x 3-1/4" (b) 1 Pc. 1-3/8" Dia. x 2-1/2"	
7	4	Aerocase - 3/8" Dia. x 5/8"	C.R.S.

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Figure 38—Dimensions of Alignment Tool

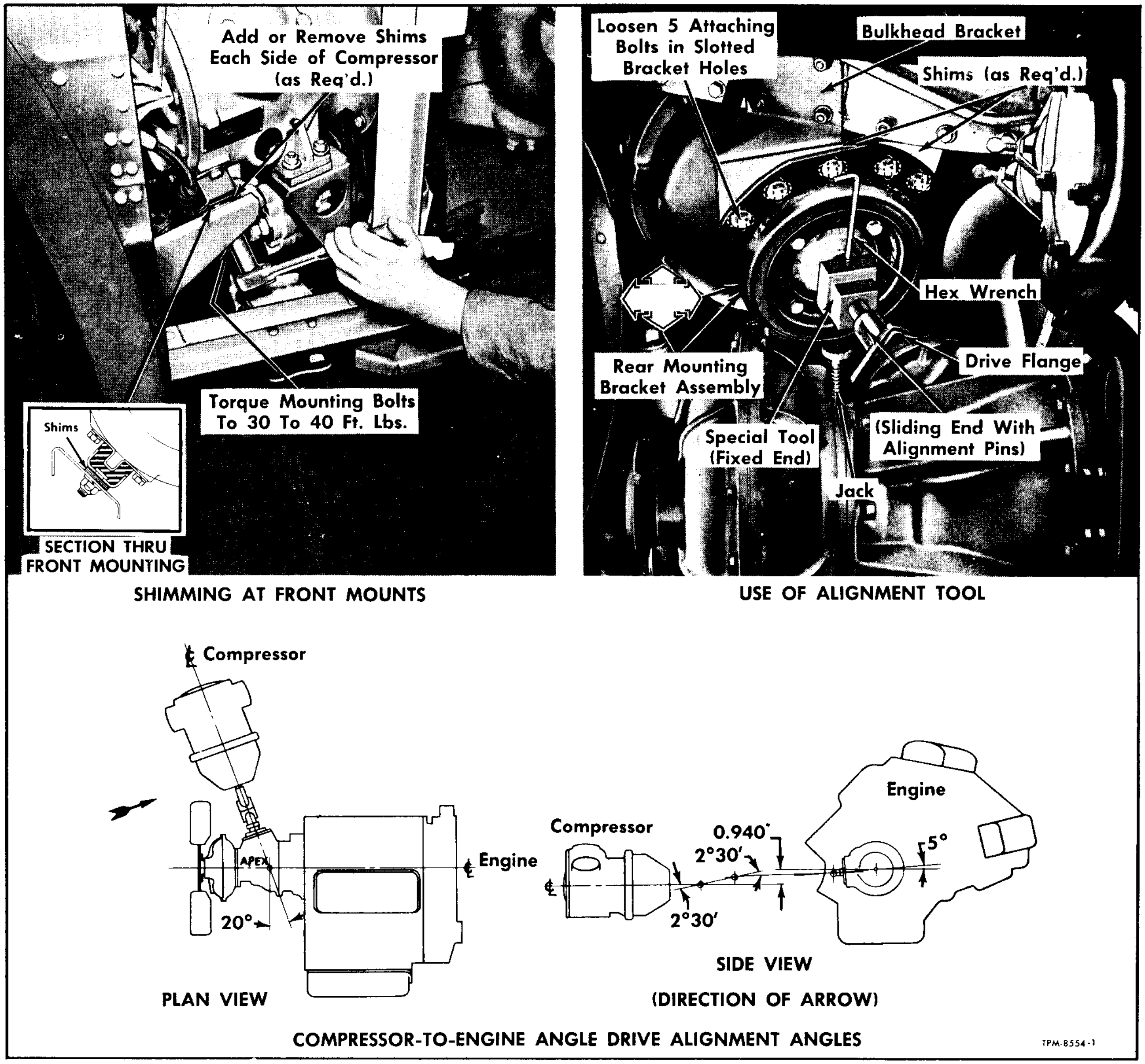


Figure 39—Aligning Compressor Using Special Tool

23. Connect clutch control air cylinder air line (11).

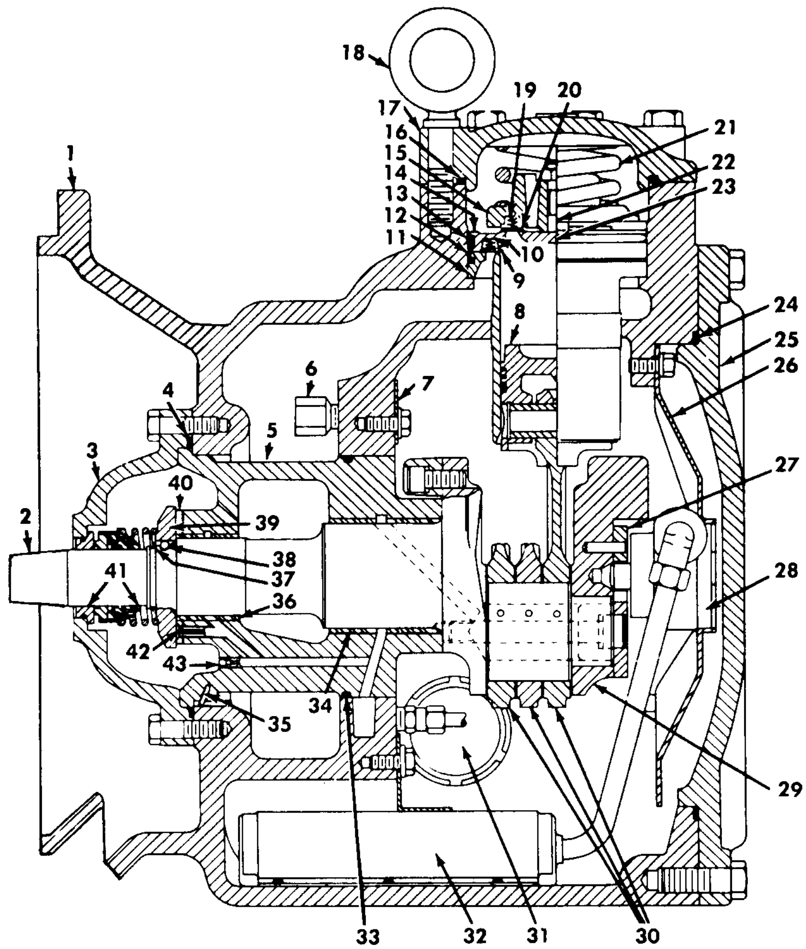
24. Accomplish services outlined later under "Refrigerant Valves," "Preparing System For Operation," "Purging The System, Testing For Leaks," and "Checking For Air In The System," all under "SYSTEM SERVICES AND TESTS."

25. Install stone shield below compressor.

REFRIGERANT COMPRESSOR OVERHAUL

Before servicing compressor (fig. 40), the system must be pumped down and the unit removed from coach. Pumping down system instructions are explained later under "SYSTEM SERVICES AND TESTS." See "Pumping Down The System." Instruction procedures for removing compressor are explained previously under "Compressor Replacement."

The immediate area in which the compressor is to be overhauled should be dust-free and if pieces of cloth are to be used for the cleaning of parts, they should be of the lint-free type.



1 Compressor Housing
2 Compressor Crankshaft
3 Seal Cover
4 Bearing Head O-ring Seal
5 Bearing Head
6 Gas Check Valve Assembly
7 Foam Breaker Plate
8 Piston Assembly
9 Suction Valve
10 Suction Valve Spring
11 Cylinder Liner
12 Retaining Ring
13 O-ring Seal
14 Suction Valve Plate
15 Discharge Valve Cage
16 Cylinder Head O-ring Seal
17 Cylinder Head
18 Eye Bolt
19 Discharge Valve Spring
20 Discharge Valve
21 Cylinder Head Spring
22 Discharge Valve Bolt
23 Discharge Valve Seat
24 Hand-hole Cover O-ring Seal
25 Hand-hole Cover
26 Oil Pump Mounting Bracket
27 Oil Pump Drive Assembly
28 Oil Pump Assembly
29 Crankshaft Counterweight
30 Connecting Rods
31 Sight Glass
32 Oil Strainer Assembly
33 O-ring Seal
34 Crankshaft Bearing (Large)
35 Locating Pin
36 Crankshaft Bearing (Small)
37 Retaining Ring
38 Thrust Collar Ball
39 Thrust Collar
40 Thrust Washer
41 Seal Assembly
42 Thrust Washer Pin
43 Oil Restriction Plug

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Figure 40—Sectional View of Refrigerant Compressor

When servicing parts of compressor, handle the parts carefully and protect them against rusting immediately upon removal from compressor housing. Before installing parts, wash with refrigeration compressor parts cleaner, then oil with new (clean) compressor oil. This applies especially to seal and bearing surfaces to prevent seizure when unit is first put in operation. Use new O-ring seals and gaskets at build-up of compressor.

The design of compressor permits replacement of many components and sub-assemblies without having to disassemble balance of compressor. For example cylinder line can be replaced without having to remove piston and rod. However, the overhaul procedures described herein covers complete disassembly of compressor in logical sequence and to the extent recommended by the manufacturer.

COMPRESSOR DISASSEMBLY

(Key numbers in text refer to figure 40)

SUCTION VALVE PORT SCREEN REMOVAL

Remove rubber O-ring gasket at top of suction valve port then lift screen from opening as shown in figure 41.

CYLINDER HEAD AND DISCHARGE VALVE REMOVAL AND DISASSEMBLY

1. Remove all but two opposed cylinder head attaching bolts. Back off remaining bolts two or three full turns.
2. Examine cylinder head (17) to see if head is following the attaching bolts (fig. 42). If not, tap the head with a plastic hammer until head O-ring seal (16) breaks loose.

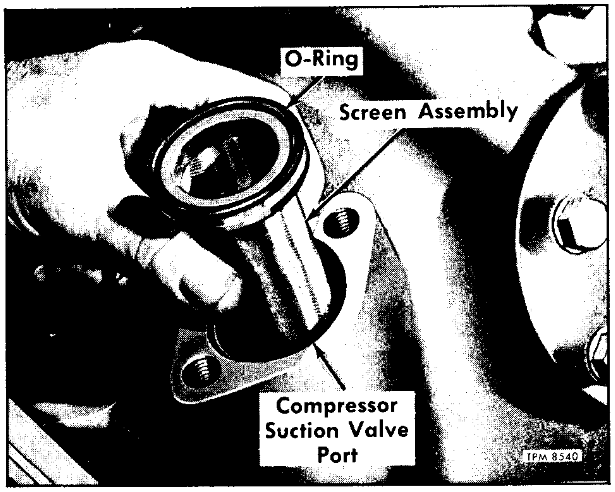


Figure 41—Replacing Compressor Suction Valve Screen

3. Slowly and alternately remove two cylinder head bolts. Remove head and cylinder head spring (21) from compressor.

4. Remove O-ring seal (16) from groove in cylinder head.

5. Lift discharge valve assembly (15) from compressor.

6. Remove lock nut from discharge valve bolt (22). Remove bolt and valve seat (23). Separate discharge valve (20) and four springs (19) from discharge valve cage (15).

CYLINDER LINER AND SUCTION VALVE REMOVAL AND DISASSEMBLY

NOTE: The suction valve plate (14) is tapered in toward the top. A block of soft wood should be cut and shaped to fit into this taper (fig. 43).

1. Rotate the crankshaft until piston head is down about 2 inches from top, then place the wood block into cylinder. Rotate crankshaft to cause piston (8) to press block and cylinder liner (11) with suction valve from compressor bore (fig. 44).

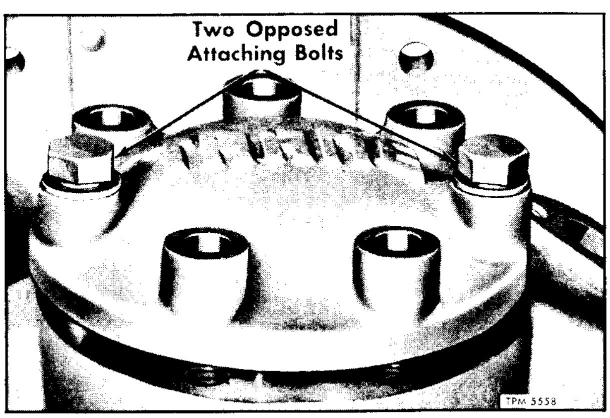


Figure 42—Method of Removing Cylinder Head Cover

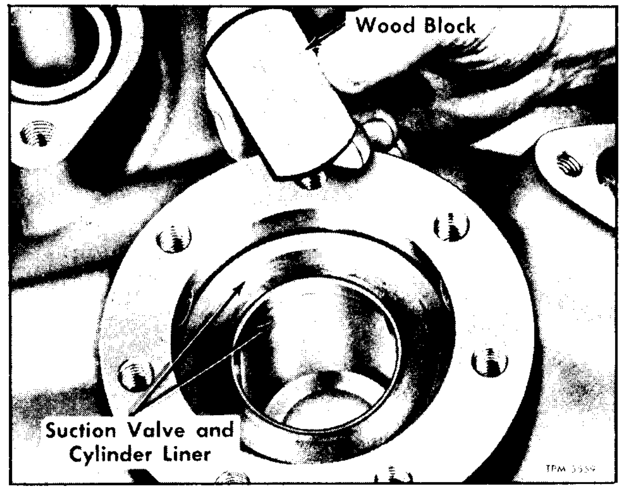


Figure 43—Wood Block Used for Removal of Suction Valve and Cylinder Liner

IMPORTANT: Do not bump piston against block, use an even pressure.

While liner is being withdrawn, support the piston through the liner so that the piston does not strike against compressor housing when liner breaks free.

2. Stand the cylinder liner and valve assembly on work bench. Remove the three valve plate retaining rings (12) from liner and plate. While not moving plate on liner, carefully invert entire assembly, then lift liner from suction valve (9), valve springs (10), and valve plate (14).

3. Remove O-ring seal (13) from suction valve plate (14).

HANDHOLE COVER REMOVAL

NOTE: Before removing cover (25) make sure that oil is drained from compressor.

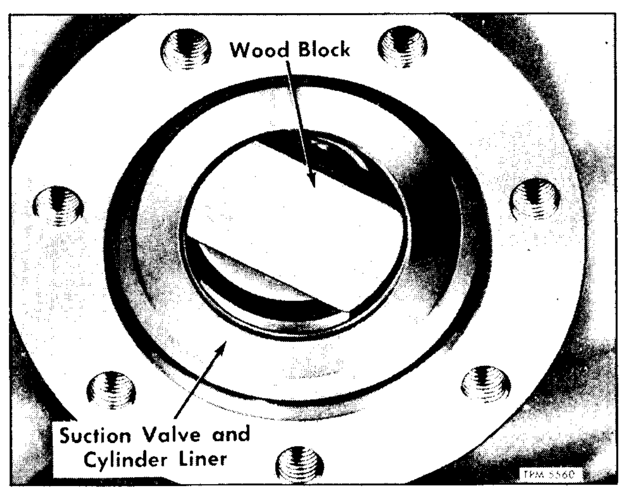


Figure 44—Removing Suction Valve and Cylinder Liner

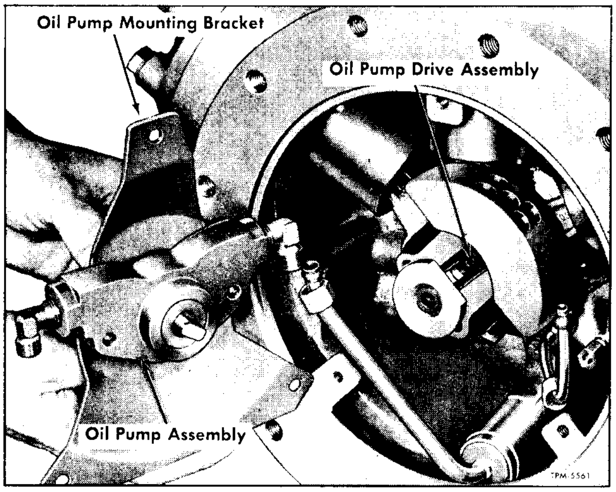


Figure 45—Oil Pump and Mounting Bracket Removed

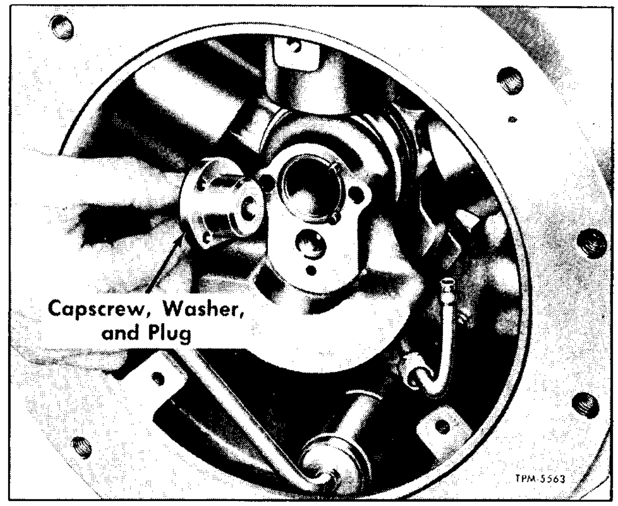


Figure 47—Replacing Counterweight, Plug, Washer, and Cap Screw

1. Remove all handhole cover attaching cap screws except the top screw. Loosen this screw only. Screw will support the weight of cover when it breaks free from cover O-ring seal at opening. Tap cover with plastic hammer if necessary to free cover.

2. Remove top screw, then withdraw cover. Remove O-ring seal (24) from cover.

OIL PUMP AND OIL STRAINER REMOVAL

1. Disconnect oil line fitting nuts from elbow at each end of oil pump assembly (28).

2. Loosen only, the two hex head cap screws which attach oil pump assembly to the oil pump mounting bracket (26).

3. Remove the three cap screws which attach the oil pump bracket to compressor housing. Withdraw pump and pump bracket from compressor making sure oil lines are completely disengaged from elbows (fig. 45).

4. Remove the two cap screws previously loosened, attaching oil pump assembly to pump bracket. If necessary remove line elbows from pump.

NOTE: Do not attempt to repair pump assembly. If pump becomes inoperative, the complete assembly should be replaced.

5. Rotate crankshaft so that counterweight (29) is at top. Remove cap screw and lock washer attaching oil strainer assembly (32) to compressor housing. Remove strainer assembly.

CONNECTING ROD AND PISTON REMOVAL AND DISASSEMBLY

NOTE: Remove connecting rods and pistons in following sequence: From center cylinder first,

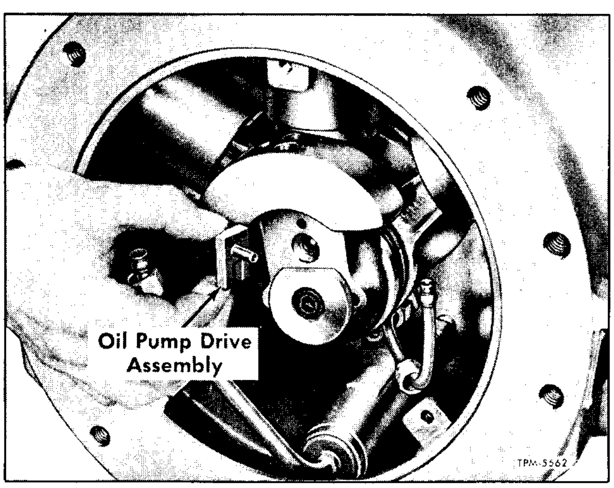


Figure 46—Removing Oil Pump Drive Assembly

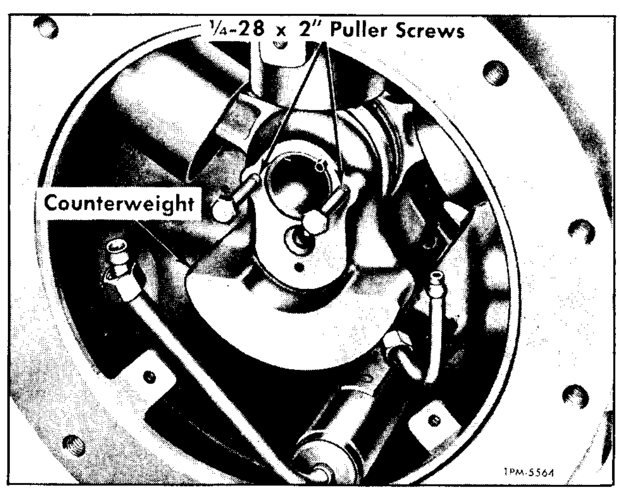


Figure 48—Method of Pulling Crankshaft Counterweight

from left-hand cylinder next, and right-hand cylinder last.

1. Remove the oil pump drive assembly (36) in manner shown in figure 46.

2. Remove socket head cap screw, lock washer, and plug which retain counterweight (29) on compressor crankshaft (fig. 47). Use two puller screws (1/4-28 x 2") to force counterweight from crankshaft (fig. 48). Use care not to loosen the two dowel pins in counterweight.

3. Remove connecting rods and pistons carefully from compressor in sequence stated above.

4. Remove piston rings from piston.

5. Using a Tru-Arc pliers, remove two snap rings holding piston wrist pin in piston. Drive pin from piston and rod using a wood or soft metal driver. Do not nick piston or distort the wrist pin hole.

COMPRESSOR SHAFT SEAL REMOVAL

1. Loosen and remove all but two opposed cap screws which retain seal cover (3) to compressor housing (1) (fig. 49). Slowly and alternately turn remaining two cap screws from housing making sure seal cover follows screws. Seal spring should force cover from compressor housing. If necessary, tap cover lightly with plastic hammer to break seal between cover and housing.

2. Remove seal cover evenly from compressor shaft so as not to damage seal assembly (41). Pull seal assembly carefully from compressor shaft.

3. Remove rubber O-ring seal (4) from seal cover or bearing head.

CRANKSHAFT AND BEARING HEAD REMOVAL AND DISASSEMBLY

1. Tip the compressor upright on work bench (pump end downward). Grasp end of crankshaft, then slowly and carefully pull the crankshaft and bearing head assembly from compressor.

2. Place crankshaft and head assembly on clean work bench. Remove rubber O-ring seal (33) from groove in bearing head (5).

3. Using Tru-Arc pliers, remove snap ring (37) which retains thrust collar (39) on shaft. Remove thrust collar and the small ball (38) from depression on crankshaft (fig. 50).

4. Slide bearing head (5) from crankshaft.

5. If necessary, thrust washer (40) and oil restriction plug (43) can be removed from bearing head.

NOTE: Crankshaft bushings (34 and 36) in bearing head are not serviced. If bushings are worn considerably, replace bearing head assembly.

FOAM BREAKER REMOVAL

Two foam breaker screens are located in compressor cavities as shown in figure 51.

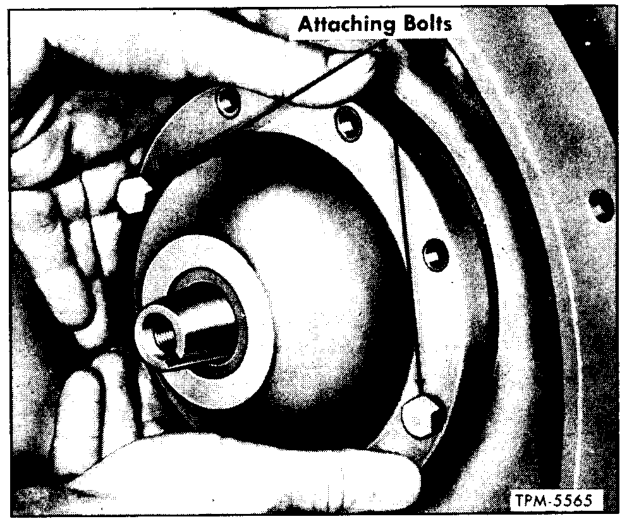


Figure 49—Method of Removing Crankshaft Seal Cover

Remove three screws and lock washers which attach the foam breaker retaining plate (7) to compressor housing. Remove plate, then remove foam breaker screens.

RELIEF VALVE, OIL LINE FITTING, OIL CHECK VALVE AND GAS CHECK VALVE REMOVAL

1. Relief valve, oil line fitting, and oil check valve are located at rear of compressor as shown in figure 51. Remove these units from compressor housing.

2. Gas check valve assembly (6) is located in the suction cavity of compressor housing as shown. Using a short handle wrench, remove valve.

CLEANING AND INSPECTION

CLEANING

1. Clean all compressor components in refrigeration compressor parts cleaner. Use a stiff bristle brush if necessary to loosen foreign par-

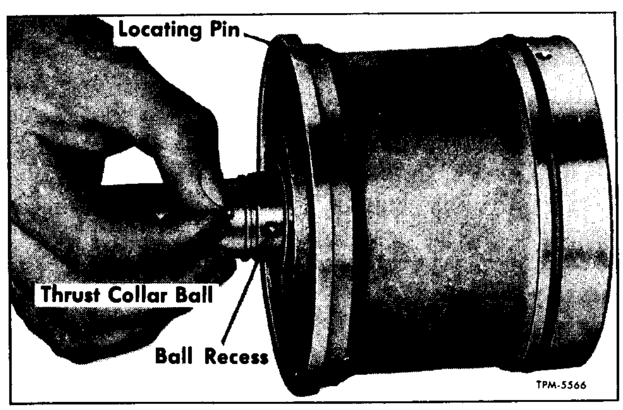


Figure 50—Thrust Collar Ball Location

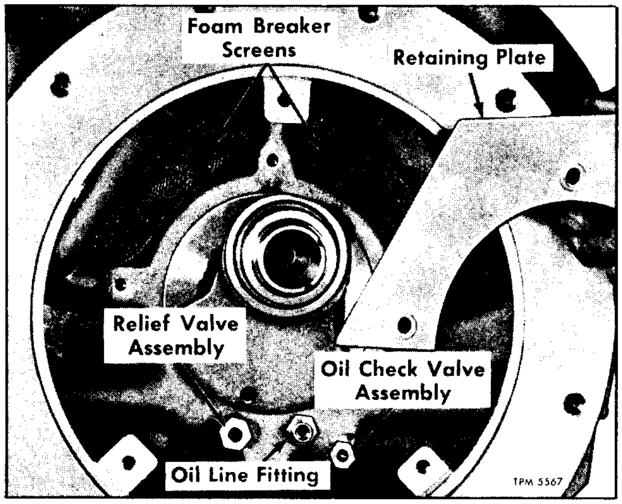


Figure 51—Foam Breaker, Screens, and Valves Installed

ticles. Direct compressor air through all passages in castings.

2. Use a small soft wire to clean oil restriction plug (43, fig. 40) in bearing head.

INSPECTION

1. Inspect compressor housing and other tapped components for cross threads and other damage.

2. Relief valve, gas check valve, and oil check valve can be disassembled and components cleaned and inspected. If ball within unit does not seat properly, replace entire valve assembly.

3. Examine surfaces of compressor valve components. Replace worn parts.

4. Inspect pistons for scoring, cracks, or damage of any kind.

5. Check fit of rings in piston ring grooves. Use back edge of ring to check fit (fig. 52). Rings should move freely in piston grooves.

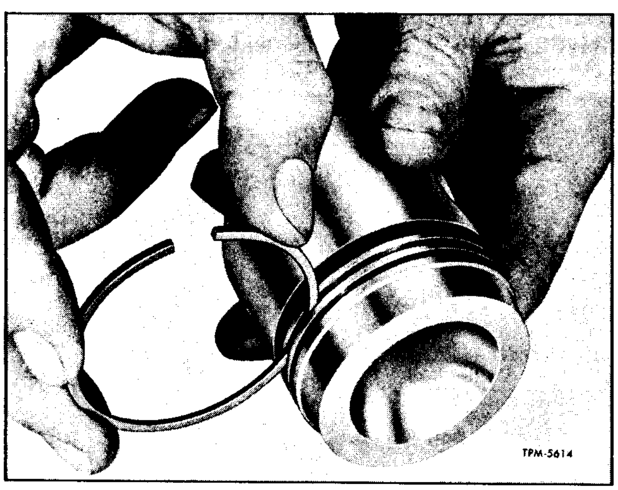


Figure 52—Checking Piston Ring Groove Clearance

COMPRESSOR BUILD-UP

Before building up compressor, coat all components with clean compressor oil. This will provide initial lubrication and prevent rusting.

Use new O-ring seals when assembling compressor.

NOTE: Key numbers in following text refer to figure 40.

RELIEF VALVE, OIL LINE FITTING, OIL CHECK VALVE, AND GAS CHECK VALVE INSTALLATION

1. Install gas check valve assembly (15) into compressor housing. Tighten valve firmly.

2. Install relief valve, oil line fitting, and check valve into rear of compressor as shown in figure 51. Tighten units firmly.

FOAM BREAKER INSTALLATION

1. Carefully roll foam breaker screens into approximate shape and insert into cavities in compressor housing.

2. Install foam breaker retaining plate (7) with three screws and lock washers. See figure 51.

CRANKSHAFT AND BEARING HEAD ASSEMBLY AND INSTALLATION

1. If thrust washer (40) and oil restriction plug (43) was removed from bearing head, install these parts. Install washer with oil grooves away from bearing head.

2. Insert crankshaft (12) into bearing head, then position small ball (38) into depression on crankshaft as shown in figure 50. Install thrust collar (39) on crankshaft with groove in collar aligning over ball on crankshaft.

3. Install thrust collar retaining ring (37) against thrust collar. Be sure that retaining ring is firmly seated in crankshaft groove.

4. Install rubber O-ring seal (33) into groove at rear of bearing head (5).

5. With compressor oil applied to O-ring seal, insert crankshaft and bearing head assembly into compressor housing making sure locating pin (35) on bearing head (fig. 50) engages groove in compressor housing.

CONNECTING ROD AND PISTON ASSEMBLY AND INSTALLATION

1. Position connecting rod in piston and drive wrist pin through piston and rod using a hammer and brass driving rod. Install snap rings into piston groove at each end of wrist pin.

2. Work piston rings carefully down over piston to their proper groove, using shim stock to aid in positioning rings. Oil ring is installed in bottom groove while compression rings are installed in two upper grooves.

IMPORTANT: Compression rings are tapered.

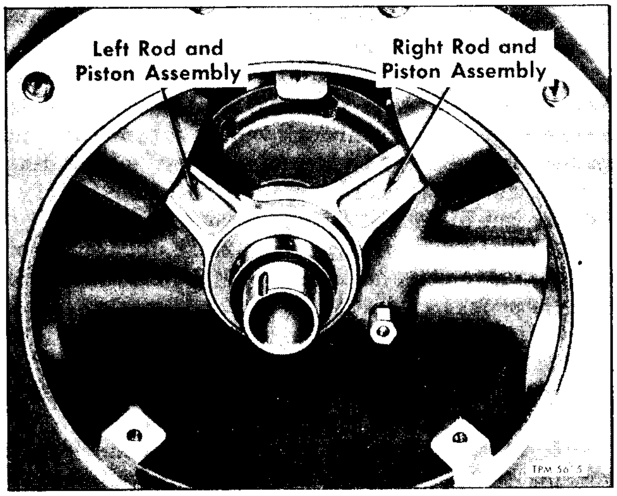


Figure 53—Right and Left Connecting Rods Installed

Taper should be checked by eye and the rings placed on piston so that ring taper is toward the top of piston. Make sure rings are free in groove.

3. NOTE: Connecting rod and piston assemblies are installed in the reverse order of their removal. As viewed from rear of compressor, install right assembly, left assembly, then the center assembly last (fig. 53).

Clean surface of crankshaft thoroughly, then lubricate freely with compressor oil.

4. Rotate crankshaft so that piston of first rod to be installed will be at bottom of its stroke. Slide rod on crankshaft.

NOTE: After placing each rod on shaft install each respective cylinder liner and suction valve assembly as explained later under "Cylinder Liner and Suction Valve Assembly and Installation."

5. Clean and oil the surface of crankshaft which is to contact the crankshaft counterweight (29). Align counterweight dowel pins with locating holes in crankshaft, then press counterweight to crankshaft. Tap counterweight to seat it firmly to shaft.

6. Install plug into crankshaft end (fig. 47). NOTE: The dowel pins which extend beyond counterweight must align with recesses in plug. Install lock washer and cap screw. Tighten cap screw to 23 foot-pounds torque.

7. Insert the oil pump drive assembly (27) in manner shown in figure 46.

SUCTION VALVE AND CYLINDER LINER ASSEMBLY AND INSTALLATION

1. Apply compressor oil to O-ring seal (13), then install seal into groove of suction valve plate (14).

2. Invert suction valve plate (14) on bench, then place four springs (10) into spring pockets. Center the suction valve (9) over springs.

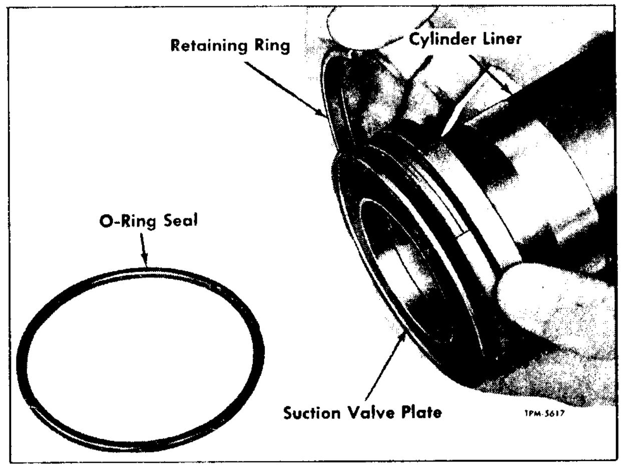


Figure 54—Installing Suction Valve Plate and Retaining Ring

3. Lower the cylinder liner (11) down over valve to suction plate, then install three retaining ring segments (12) to retain suction valve plate to cylinder liner (fig. 54). Make sure suction valve is properly seated on valve seat (fig. 55).

4. Before placing liner and valve assembly into cylinder down over piston, rotate piston rings on piston to stagger gaps of rings.

5. Rotate crankshaft to bottom of its stroke. Place the liner into cylinder and center piston below liner. Push liner down over piston and rings and rotate crankshaft to force piston up into liner.

CAUTION: Do not hammer or attempt to force liner over piston rings. A sudden shock will cause ring breakage.

OIL STRAINER AND OIL PUMP INSTALLATION

1. Guide the oil strainer assembly (32) into compressor housing. Install strainer attaching screw and lock washer. Tighten screw firmly.

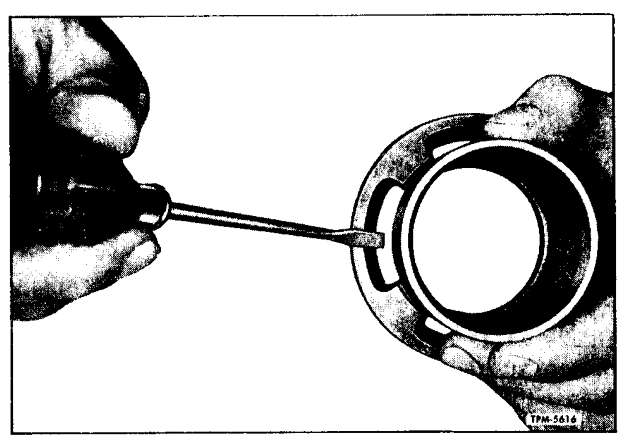


Figure 55—Checking Suction Valve Alignment

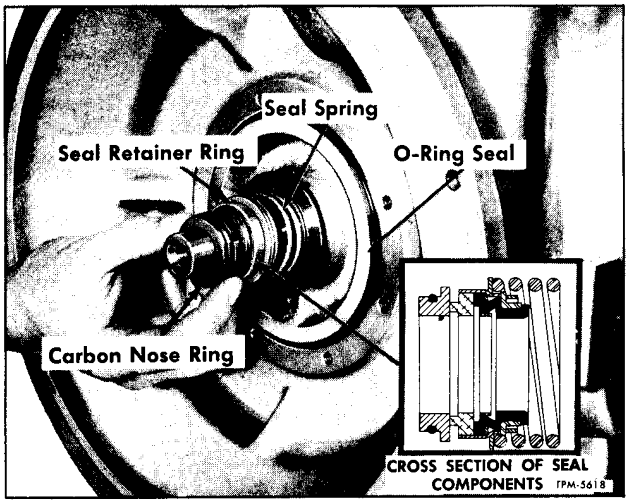


Figure 56—Installing Crankshaft Seal Components

2. Install oil line elbows into oil pump body if previously removed.

3. Attach oil pump mounting bracket (26) to oil pump with two cap screws and lock washers. Tighten screws hand tight.

4. Turn the oil pump drive key to the position required to engage oil pump drive as shown in figure 45. Position oil pump with mounting bracket in place, then attach bracket loosely to compressor housing with three cap screws and lock washers.

5. Engage and connect oil suction and discharge lines to elbows on oil pump. Tighten two pump-to-bracket attaching cap screws to 14 foot-pounds torque, and three pump bracket-to-compressor housing attaching cap screws to 6 foot-pounds torque. Tighten oil line fitting nuts to obtain leak-proof connections.

HAND HOLE COVER INSTALLATION

1. Apply compressor oil to cover O-ring seal (24), then place seal around edge of cover projection.

2. Position cover (25) with seal (24) to compressor housing. Install cover attaching cap screws evenly. Final torque screws to 43 foot-pounds.

DISCHARGE VALVE AND CYLINDER HEAD INSTALLATION

1. Invert discharge valve cage (15) on bench, then place four discharge valve springs (19) into spring pockets of cage.

2. Center discharge valve (20) over springs. Assemble valve seat (23) and seat bolt (22), then install seat and bolt through valve cage. Install nut on seat bolt. Before tightening nut, make sure discharge valve (15) registers in valve guides of cage. Tighten nut to 14 foot-pounds torque.

3. Position discharge valve assembly on top of suction valve plate in cylinder. Make certain valve cage is properly seated.

4. Place the cylinder head O-ring seal (16) around head projection.

5. Lower cylinder head spring (21) over guides of discharge valve cage in cylinder.

6. Attach cylinder head (17) to compressor housing with seven cap screws. Install cap screws evenly to a final torque of 43 foot-pounds.

COMPRESSOR SHAFT SEAL AND COVER INSTALLATION

NOTE: The seal assembly (41) must always be replaced as an assembly. Before inserting seal assembly on shaft, clean seal surface on shaft and apply compressor oil to sealing surfaces.

1. Install O-ring seal (4) against compressor or housing around bearing head (fig. 56).

2. Position seal spring on compressor shaft (fig. 56).

3. Making sure that carbon nose ring is clean, (do not touch with fingers after cleaning), wet face of ring with compressor oil. Place nose ring into ring retainer, making sure that notches in retainer are properly aligned with notches in nose ring. Install seal assembly against spring (fig. 56).

4. Clean seal cover (3) and oil the O-ring seal of seal assembly (41), then install cover over seal evenly to compressor housing. Install cover attaching cap screws alternately to a torque of 12 foot-pounds.

SUCTION VALVE PORT SCREEN INSTALLATION

Making sure screen assembly is clean, insert it down into compressor suction valve port, then place O-ring seal over screen flange as shown in figure 41.

NOTE: If compressor is not to be installed at this time, install closure plates (fig. 35) with gaskets over valve ports.

COMPRESSOR DRIVE

Compressor, mounted in coach as shown in figure 31, is driven through an air-operated disc clutch which is mounted to drive end of compressor. Clutch is propeller shaft driven from accessory drive unit mounted to fan end of coach engine (fig. 57).

The condenser fan drive pump is belt-driven through the compressor drive clutch from a pulley integral with compressor flywheel.

Clutch is engaged by air pressure admitted through an electrically-operated air valve (fig. 4). Air pressure from solenoid valve to the clutch is supplied through a flexible air line.

When air pressure is applied to clutch cylin-

der the clutch is engaged. When air pressure is exhausted from cylinder, clutch becomes disengaged. Spring within cylinder removes the pressure from clutch plate.

Procedures for removing and overhauling the clutch assembly are explained later under "Compressor Drive Clutch." Overhaul procedures of clutch assembly is explained also later under "Compressor Drive Clutch."

COMPRESSOR DRIVE OPERATION

With "VENTILATION" switch on control panel at left of driver is placed in "AIR CONDITION" position, and with the engine oil pressure being less than 15 psi and the pressure in coach air system at 65 psi or more, the clutch control solenoid valve becomes energized. With solenoid valve operating coil energized, air pressure is permitted to clutch air cylinder through the flexible line which releases pressure from clutch cover spring causing clutch to become engaged. Lower view of figure 62 shows clutch in the engaged position, air pressure applied. The upper view of figure 62 shows disassembled components of clutch.

Refer to Schematic Wiring Diagram (fig. 2) for electric circuits.

COMPRESSOR DRIVE MAINTENANCE

The following instructions apply to items which require periodic inspection and adjustment. Maintenance information on compressor drive propeller shaft, accessory drive clutch, and clutch control air cylinder is explained later under respective headings.

Inspect clutch drive components, making sure clutch housing bolts and drive shaft universal joint flange bolt nuts are tight.

CLUTCH CONTROL AIR PRESSURE CHECK

In manner shown in figure 58, check the air pressure to clutch control cylinder. Disconnect air line between solenoid valve and air cylinder, and install a test air pressure gauge as shown. Deplete pressure in coach air system down to 40 to lbs. or even less. While observing test gauge, have assistant start engine and place air conditioning control to operating position. Note pressure on gauge at time solenoid valve releases air pressure to test gauge. Solenoid valve should be energized (opened) by the air pressure switch at 65 ± 3 lbs. If this does not occur, replace air pressure switch (fig. 58), then recheck pressure to test gauge.

LUBRICATION

Instructions for lubricating compressor drive components are explained in LUBRICATION (SEC. 13) of this manual.

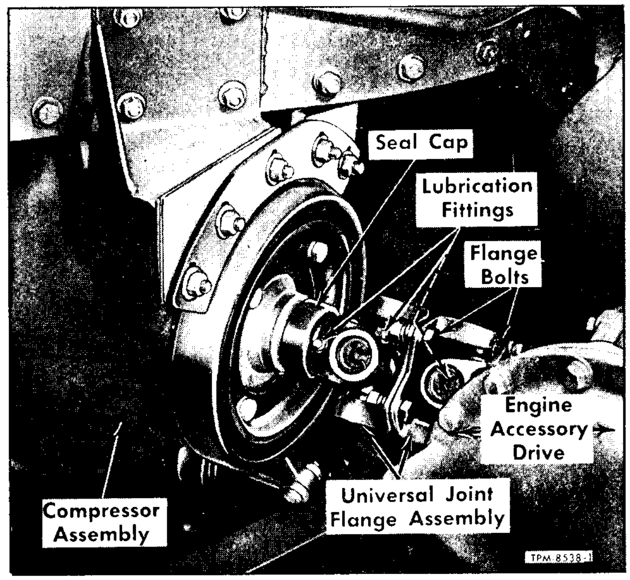


Figure 57—Compressor Drive Shaft Installed

COMPRESSOR CLUTCH RELEASE FORK ADJUSTMENT

At regular intervals the over-all clearance between the clutch driven plate, the pressure plate, and the compressor flywheel (dimension "C" fig. 62) should be checked with clutch disengaged. Clearance should measure 0.010" to 0.030". This is accomplished as follows: With clutch disengaged, air cylinder push rod extended, measure plate clearance through hole in bottom of clutch housing

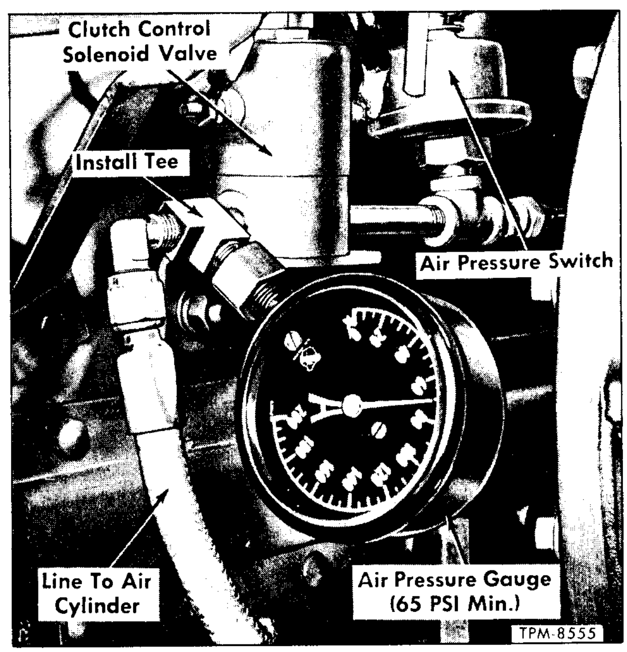


Figure 58—Clutch Control Cylinder Air Pressure Check

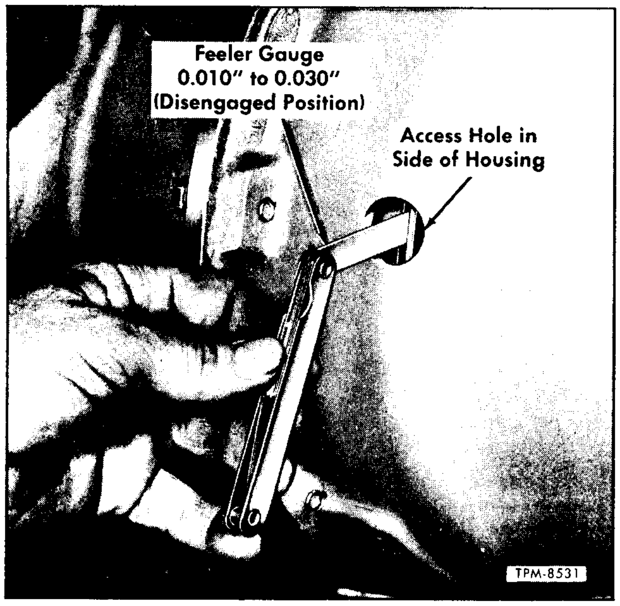


Figure 59—Checking Clutch Drive Plate Clearance

and one of the holes in pressure plate cover (fig. 59). Clutch cover must be rotated so that holes will line up to insert feeler. If clearance is not as specified, make adjustment as follows:

With clutch cylinder push rod in the retracted position, or air pressure applied, and with release bearing resting against the Belleville spring, locate yoke on push rod so that hole in clutch release fork is one-half of a hole out of alignment with

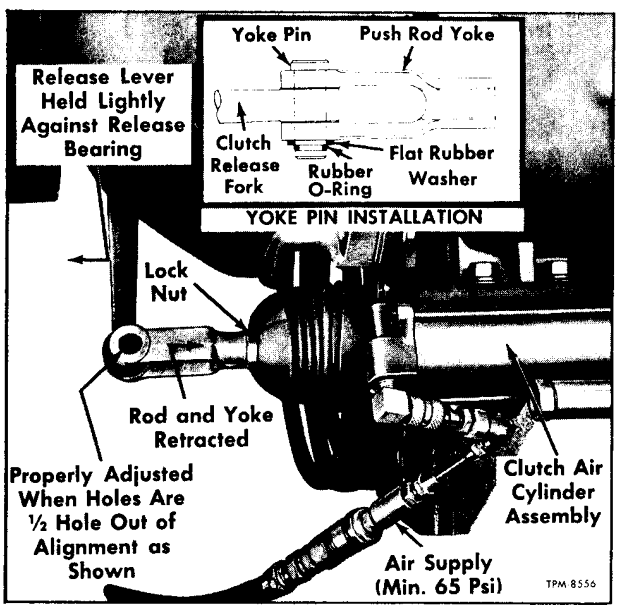


Figure 60—Air Cylinder Push Rod to Release Fork Adjustment

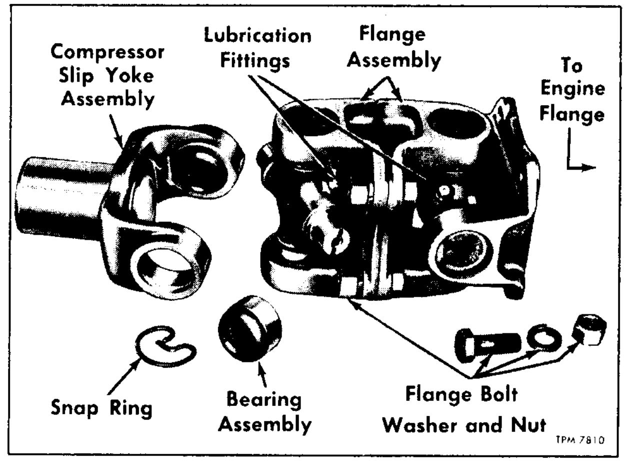


Figure 61—Compressor Drive Propeller Shaft Removed

hole in yoke, the hole in fork being further away from the air cylinder (fig. 60). Swing release fork so that its hole will line up with yoke hole and insert pin. Extend push rod by shutting off air supply to air cylinder. Push rod should move out a minimum of 1.900 inches. Measure plate clearance through hole in bottom of clutch housing. If clearance is not enough, screw yoke further out on push rod and vice versa.

With clutch in the engaged position (air pressure applied), release bearing should clear the Belleville spring by at least 1/16 inch (dimension "B," fig. 62). If there is less than 1/16 inch it means that more stroke is being applied to spring than is necessary to get .010-.030 inch plate clearance. Distance of release bearing from Belleville spring can be checked by removing pin through yoke and release fork and swinging bearing against spring by hand. Then gradually move bearing away from spring, observing distance the outer end of release fork travels. A 3/16 inch movement at outer end is equal to 1/16 inch at the inner end. After correct adjustment is obtained, lock jam nut against yoke and place rubber holding washer and O-ring on end of pin (see inset, fig. 60).

COMPRESSOR DRIVE PROPELLER SHAFT

Compressor drive propeller shaft assembly consists of components shown installed in figure 57. Figure 61 shows propeller shaft assembly removed and partly disassembled.

The slip yoke end of shaft assembly engages splines of the compressor clutch shaft. All universal joints are of needle-bearing type construction as shown and can be readily replaced if necessary. Procedure for replacing bearing assemblies is explained later.

PROPELLER DRIVE SHAFT REMOVAL

NOTE: Refer to figure 57.

Split center universal joint flanges by removing four flange attaching bolts then remove four bolts attaching flange to engine accessory drive flange. Remove center flange unit assembly. Slide front slip-yoke assembly from clutch shaft.

UNIVERSAL JOINT BEARING REPAIR AND REPLACEMENT

Disassembly (Refer to Fig. 61)

1. Remove snap rings retaining bearings in flange yoke.
2. Using a soft hammer, drive journal sideways and push one bearing out of yoke.
3. Turn yoke over and drive journal in opposite direction to remove opposite bearing.

NOTE: Do not permit rollers to drop out of bearing race. Use care to prevent damage to, or loss of rollers.

4. Remove journal from yoke.

Cleaning and Inspection (Refer to Fig. 61)

1. Wash all parts in cleaning solvent to remove all dirt and old lubricant. Make sure lubricant passages in journal are clean.
2. Check for twisted yoke or flange.
3. Check needle bearings, bearing race, and journal for visual wear or damage.
4. Pack race one-third full of grease to retain rollers; then place on journal to check fit. If excessive clearance is evident, replace rollers, race, or journal as necessary.
5. Use new bearing seals if damaged.

Assembly (Refer to Fig. 61)

1. Insert one end of journal into yoke or flange as far as possible from inside of yoke; then tilt assembly until opposite end of journal clears yoke and drops into position.
2. Press bearing assembly on two opposite journal arms. Press bearings enough to permit installation of snap rings into yoke grooves. Tap journal lightly with soft hammer to force bearing outward against snap rings.
3. Position opposite two bearing assemblies on journal and install snap rings.

PROPELLER DRIVE SHAFT INSTALLATION

NOTE: Refer to figure 57.

1. If there is any indication of excessive lubricant leakage at slip yoke surface, the cork seal within seal cap at clutch should be replaced. Cork seal of split-type can be removed after removing cap which is crimped at front to clutch housing bearing retainer. Install new seal and cap. Crimp cap flange after installing.
2. Slide slip yoke and flange assembly onto clutch shaft.
3. Attach center flange assembly to adjacent flanges with eight bolts, nuts and lock washers. Tighten bolt nuts firmly.

REFRIGERANT COMPRESSOR DRIVE CLUTCH

The compressor drive clutch (fig. 62) enclosed by an aluminum housing is mounted to drive end of compressor. Clutch is of the conventional automotive type and is actuated by an air powered cylinder assembly pivot mounted to side of compressor.

When air cylinder is pressurized (push rod retracted), the clutch becomes engaged. Likewise when pressure is exhausted from cylinder (push rod extended) clutch becomes disengaged. NOTE: Air cylinder push rod is extended by pressure of coil springs within cylinder assembly.

The clutch input shaft, which is propeller shaft driven from engine accessory drive is engaged directly to the clutch drive plate assembly. Thus the drive plate is turning whenever the coach engine is running. When clutch is engaged by action of the air cylinder, the Belleville spring of clutch pressure plate is released. This action releases pressure plate to engage both drive plate and compressor flywheel to operate the compressor. Large arrows on figure 62 indicate the power flow from the drive shaft input through the clutch to the compressor.

CLUTCH REMOVAL AND DISASSEMBLY

NOTE: Clutch unit can be removed from compressor while compressor is installed in coach if desired.

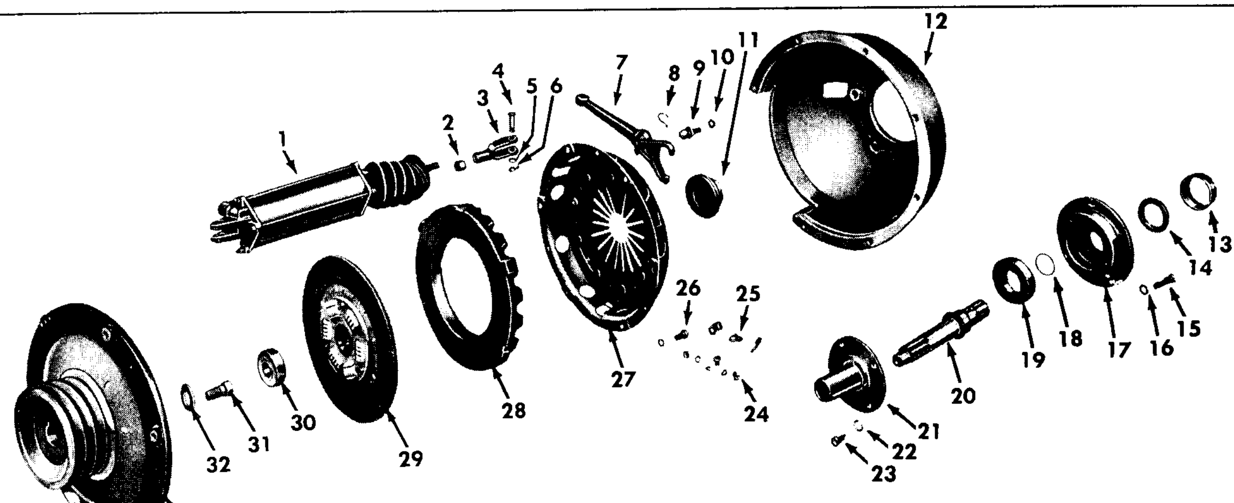
The following describes the above mentioned operation.

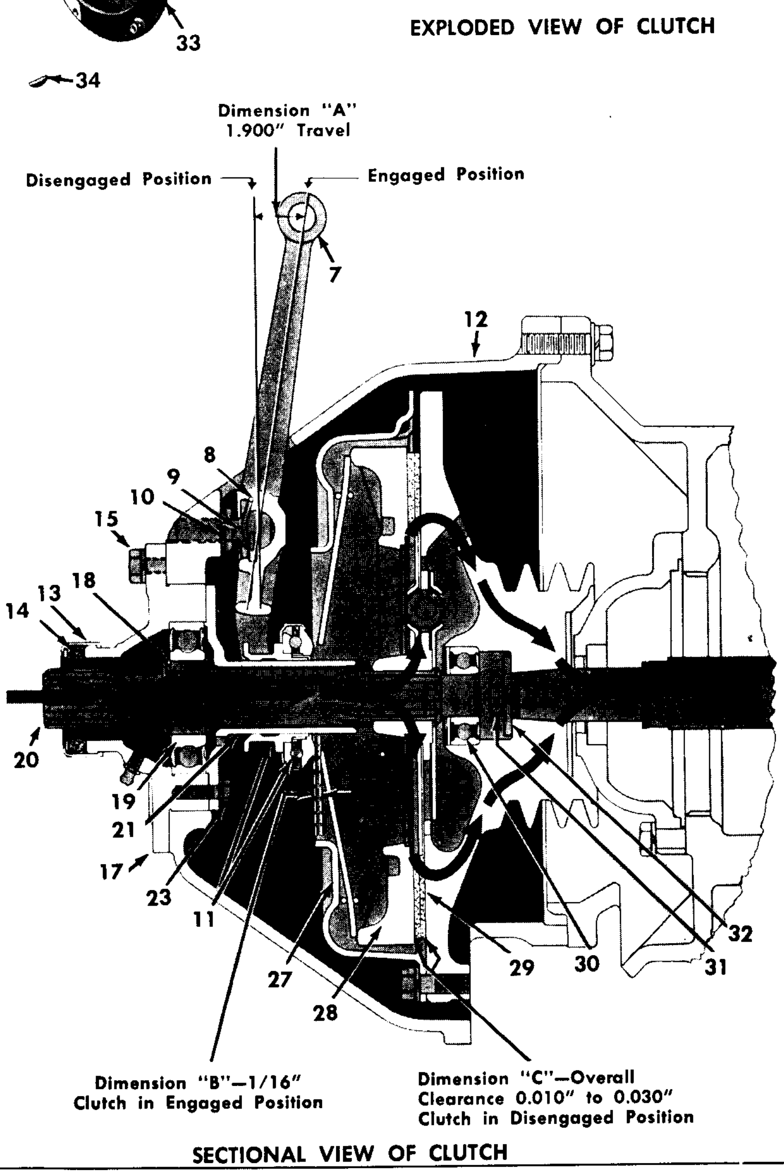
Figure 63 shows view of clutch housing assembly separated from compressor.

NOTE: Key numbers in text refer to figure 62.

1. Remove stone shield from below compressor and from below coach engine at left side.
2. Swing radiator core outward and block in full-open position.
3. Remove fan blade from engine.
4. Remove muffler and exhaust pipe from engine.
5. Remove compressor drive propeller shaft assembly as directed previously under "Compressor Drive Propeller Shaft."
6. In order to remove pin which secures clutch release fork to air cylinder push rod yoke, apply shop air pressure to cylinder which will relieve

AIR CONDITIONING





1 Clutch Control Air Cylinder Assembly
2 Lock Nut
3 Push Rod Yoke
4 Yoke Pin
5 Yoke Pin Retainer Washer
6 Yoke Pin O-ring
7 Clutch Release Fork
8 Retainer Spring
9 Ball Stud
10 External Lock Washer
11 Clutch Release Bearing Assy.
12 Clutch Housing
13 Cork Seal Retainer Cap
14 Cork Seal
15 Carrier Attaching Bolt
16 Lock Washer
17 Main Bearing Carrier
18 Bearing Retainer Ring
19 Main Bearing Assembly
20 Clutch Shaft
21 Main Bearing Retainer
22 Lock Washer
23 Retainer Attaching Bolts
24 Spring Attaching Screws and Washers
25 Pressure Plate Retracting Springs
26 Cover-to-Flywheel Attaching Bolts and Washers
27 Pressure Plate Cover Assembly
28 Pressure Plate
29 Drive Plate Assembly
30 Clutch Shaft Pilot Bearing Assy.
31 Flywheel-to-Compressor Shaft Bolt
32 Flat Washer
33 Compressor Flywheel
34 Flywheel-to-Compressor Drive Key

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Figure 62—Compressor Clutch Components

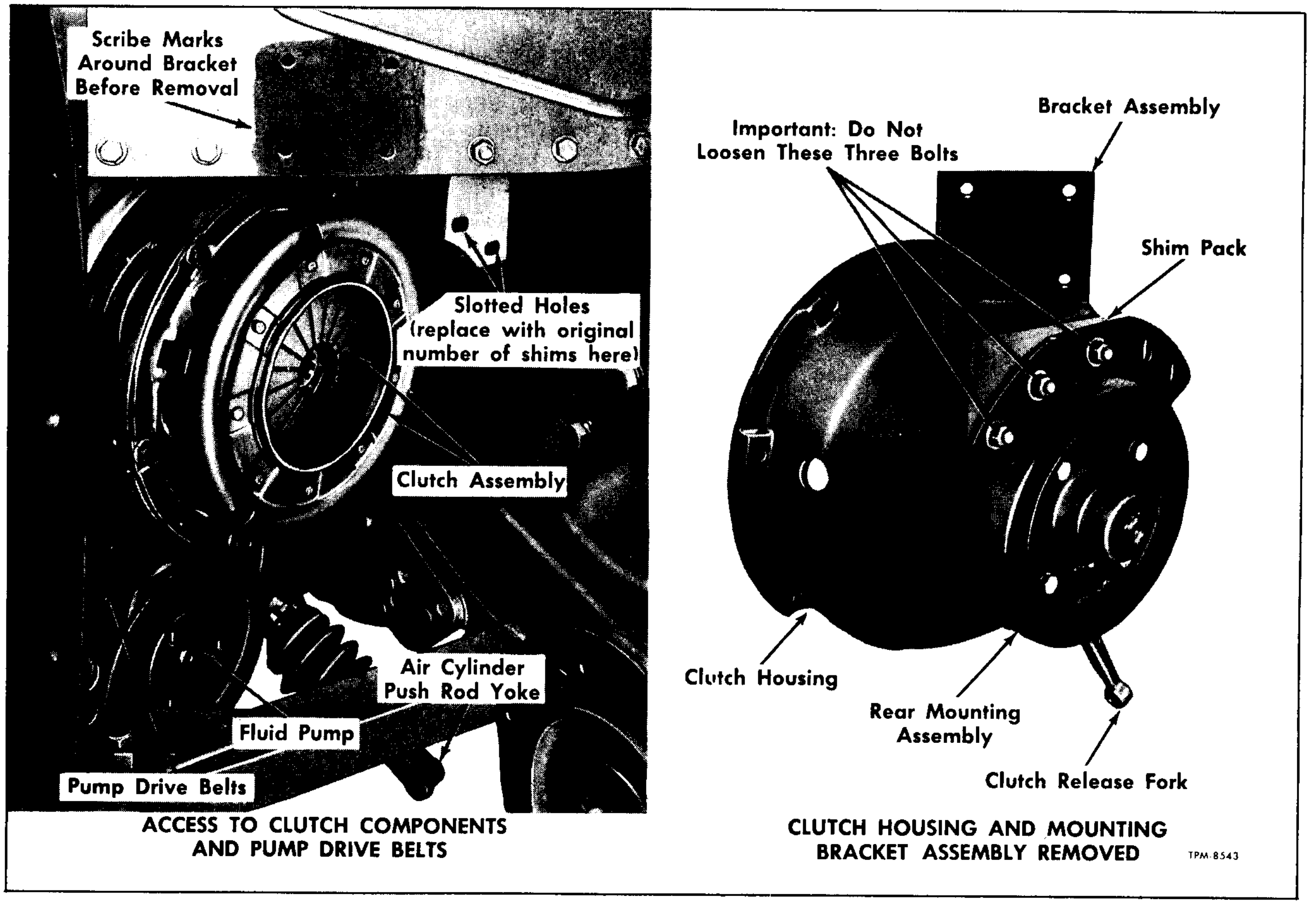


Figure 63—Clutch Housing Assembly Removed from Compressor

pressure on yoke pin. Remove pin.

7. Place a jack under fluid pump mounting bracket to support weight of compressor at drive end.

8. Scribe a line around sides and top of compressor drive end mounting bracket at the coach bulkhead. See figure 63.

9. Observe the "IMPORTANT" note in the right view of figure 63. Also note the number of shims located between compressor drive end mounting bracket assembly and the bulkhead small inboard bracket. Remove two bolts and nuts which attach the inner side of mounting bracket to small bulkhead bracket. Remove shims.

10. Remove the four bolts which attach the upper end of compressor drive end mounting bracket to bulkhead. IMPORTANT: Do not loosen three bolts shown in right view of figure 63, otherwise it will be necessary to realign compressor with accessory drive output shaft when installed later.

11. Remove seven bolts and washers which attach clutch housing to compressor housing.

12. With weight of compressor properly supported on jack, separate clutch housing assembly from clutch housing. NOTE: Two puller screws (3/8-18 x 2-1/2") (one each side of compressor housing as shown in figure 64) can be employed for removing housing evenly. NOTE· At this point the

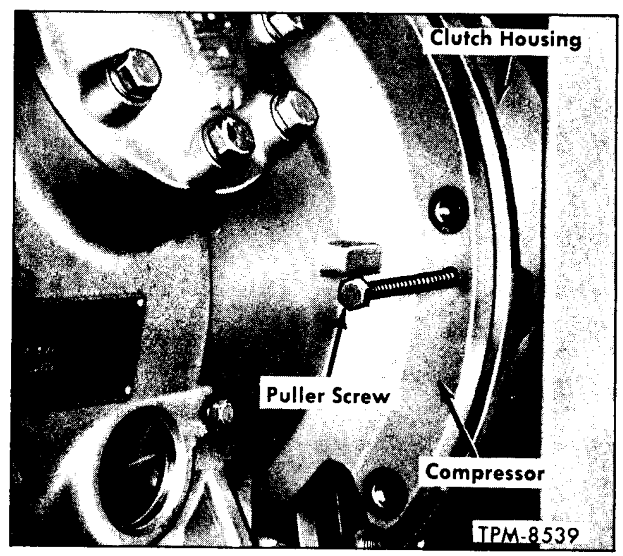


Figure 64—Using Puller Screws at Clutch Housing

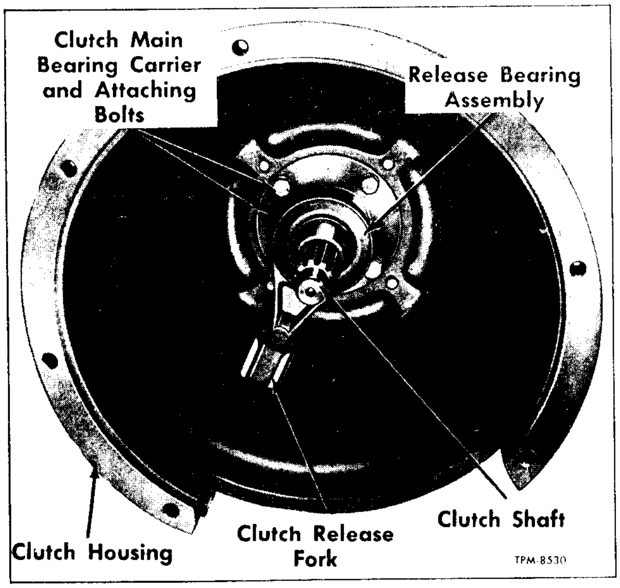


Figure 65—Clutch Fork and Drive Shaft Installed in Clutch Housing

drive end of compressor can be lowered with jack to allow clutch housing to clear bulkhead rail upon removal. Removed housing assembly with attached mounting bracket is shown in right view of figure 63. NOTE: At this point the condenser fan drive pump belts can be loosened and replaced.

13. Mark the clutch cover (27) in relation to compressor flywheel (33) to assure original alignment when reassembled later, then alternately remove bolts which attach cover to flywheel. Remove cover assembly (27) and drive plate (29).

14. If necessary clutch shaft pilot bearing (30) can be pulled from recess at hub of flywheel using a conventional bearing puller.

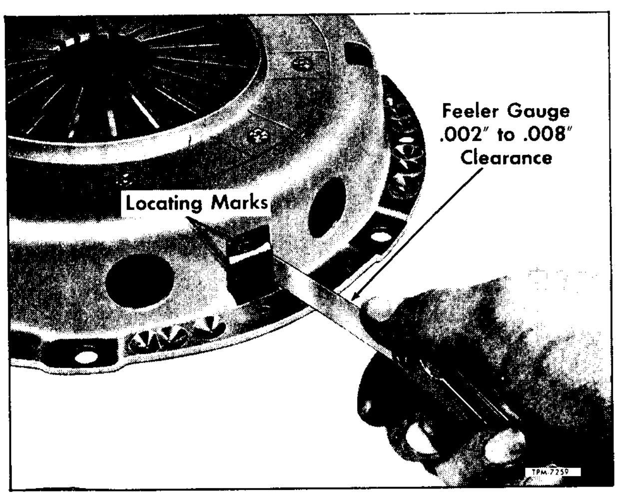


Figure 66—Clutch Cover-to-Plate Alignment Marks and Driving Lug Clearance Check

CLUTCH HOUSING AND SHAFT DISASSEMBLY

NOTE: Key numbers in text refer to figure 62.

1. Using a suitable wrench, turn ball stud (9) and lock washer (10) from clutch housing (fig. 65). Remove stud with clutch release fork (7). Slide release bearing (11) from retainer (21). Remove retainer spring (8) holding ball stud in fork.

2. Remove four bolts (15) and lock washers (16) which attach main bearing carrier and housing mounting bracket to clutch housing. Remove carrier and bracket.

3. Remove four bolts (23) and lock washer (22) attaching main bearing retainer (21) to main bearing carrier. Remove retainer and carrier from clutch shaft (20).

4. Using snap ring pliers, remove bearing retainer ring (18) from clutch shaft. Using arbor press, force main bearing assembly (19) from shaft.

CLUTCH COVER DISASSEMBLY

NOTE: Key numbers in text refer to figure 62.

NOTE: Check clearance between driving lugs of pressure plate (28) and mating slots in clutch cover (27) in manner shown in figure 66. If clearance is greater than .008", examine cover and lugs of pressure plate for wear and if necessary, replace worn parts.

If locating marks "O" on cover and pressure plate (fig. 66) are not visible, mark parts as shown. Remove pressure plate retracting spring bolts (24), remove springs (25), then separate pressure plate from cover.

INSPECTION AND REPAIR

NOTE: Key numbers in text refer to figure 62.

1. Wash all parts in cleaning solvent, except bearings and clutch drive plate assembly (29).

2. Carefully examine clutch cover and spring assembly (27). Check spring for wear at inner end of levers at point contacted by release bearing (11). Also look for wear and fractures at outer rim of clutch spring. Replace complete cover and spring assembly if any of the component parts are damaged or worn.

3. Inspect pressure plate (28) for scoring on contact surface. Regrind pressure plate if plate is grooved, rough, heat checked, or cracked. Replace with new plate if distorted or if driving lugs are worn.

4. Inspect contact surface of compressor flywheel (33) for grooved, or worn condition also. Flywheel can also be ground down as explained later.

5. Replace pilot bearing (30) clutch release bearing (11) and clutch shaft main bearing (19) if bearings are rough or damaged.

RESURFACING PRESSURE PLATE

Before resurfacing pressure plate a check should be made to determine whether plate has been resurfaced previously. This may be determined by measuring from the front surface of plate to the surface at rear side which is contacted by the Belleville spring. Dimension of new pressure plate is 1.0945" to 1.0970". Not more than .045 inch of stock may be removed from contact surface by grinding. If pressure plate is to be resurfaced, proceed as follows:

1. Grind off friction surface of pressure plate as necessary to produce a flat surface. If necessary to reduce plate thickness more than .045 inch to restore smooth flat surface, plate should be discarded and replaced with a new part.
2. After plate has been resurfaced, measure thickness as directed above. Subtract thickness of resurfaced plate from thickness of new plate to determine how much stock has been removed during resurfacing operation.

RESURFACING COMPRESSOR FLYWHEEL

Remove flywheel from compressor and grind from wear surface of flywheel rim, the same amount of stock as was removed from pressure plate. The last operation is necessary in order to maintain torque capacity of clutch and assure proper operation of clutch spring. When refacing is done properly, the clutch spring will be flat when clutch parts are assembled to flywheel, that is; the inner end of fingers will be in same plane as the outer rim of spring, or fingers may slant slightly rearward.

CLUTCH ASSEMBLY AND INSTALLATION

ASSEMBLY OF CLUTCH COVER ASSEMBLY

NOTE: Key numbers in text refer to figure 62.

1. Apply light coat of graphite grease on sides of pressure plate driving lugs; then install plate in cover, making sure balance mark "O" on cover (27) is matched with corresponding mark on pressure plate (28). Refer to figure 66.
2. Install three retracting springs (25) on pressure plate (28). There must not be any clearance between clutch spring and retracting spring when spring attaching screws are tight.

COMPRESSOR FLYWHEEL INSTALLATION

NOTE: Key numbers in text refer to figure 62.

Insert drive key (34) into slot of compressor crankshaft, then with flywheel aligned, position flywheel to shaft. Install flywheel flat washer (32) and special bolt (31). Tighten bolt to 70 to 75 foot-pounds torque in manner shown in figure 67.

NOTE: Flywheel can be retained when tightening bolt, using a stop pin inserted into hole in outer surface of flywheel and engaged into hole of a bench bracket or any other stop arrangement.

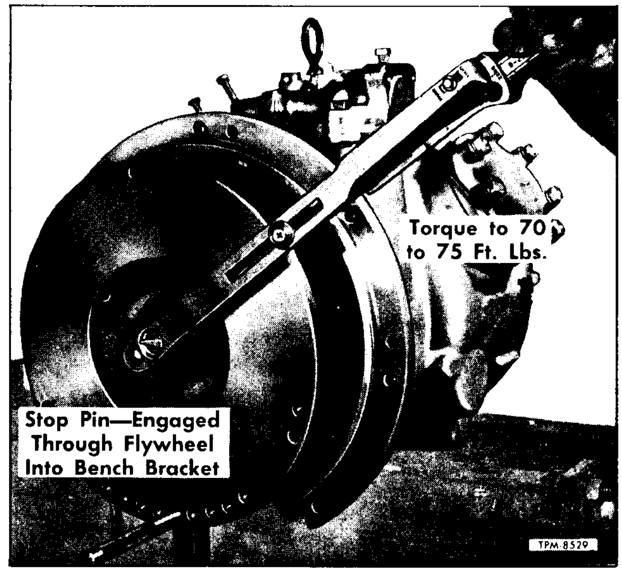


Figure 67—Torquing Compressor Flywheel Bolt

Pack cavity around head of flywheel attaching bolt with S26 lubricant as specified in LUBRICATION (SEC. 13); then with shielded side of bearing facing cavity, press pilot bearing (36) evenly into flywheel.

CLUTCH COVER INSTALLATION

NOTE: Key numbers in text refer to figure 62.

1. Making sure clutch wear friction surfaces are free of grease and dirt, set drive plate (29) in place against flywheel with extended portion of hub

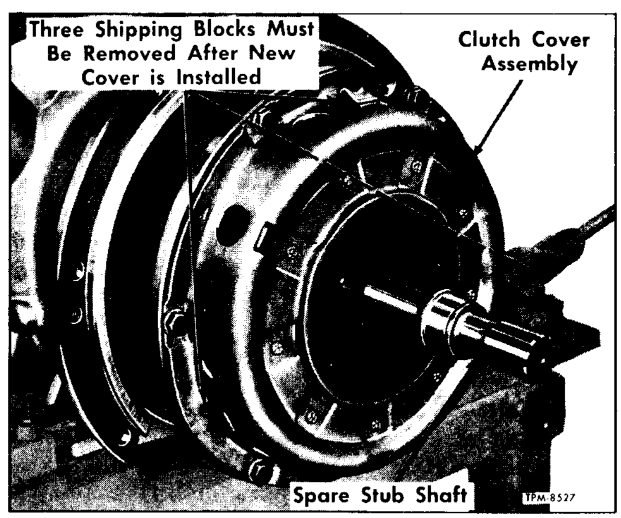


Figure 68—Using Spare Stub Shaft to Align Clutch Components

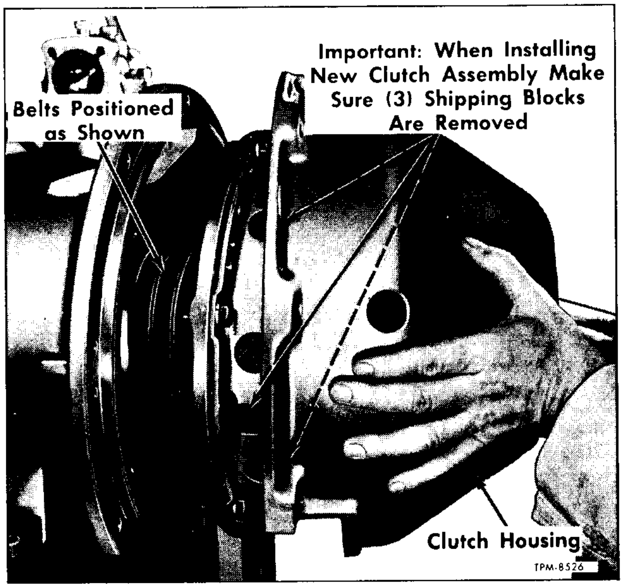


Figure 69—Installing Clutch Housing Assembly

away from flywheel. While holding plate in place, move cover assembly (27) with pressure plate (28) into place against flywheel.

2. Using a stub shaft as shown in figure 68 to align clutch drive plate, install cover attaching bolts (26) with lock washers alternately to compress clutch spring evenly and prevent possible distortion of cover flange. Remove stub shaft when all bolts are tightened to 40 foot-pounds torque.

IMPORTANT: If a new cover assembly was installed, pry three shipping blocks from around cover. Blocks are located as shown in figure 68.

ASSEMBLY OF CLUTCH HOUSING AND SHAFT

NOTE: Key numbers in text refer to figure 62.

1. Press main bearing assembly (19) onto clutch shaft (20) making sure unshielded side of bearing is toward flange on shaft.

2. Install bearing retainer ring (18) into ring groove on shaft.

3. Pack cavity of main bearing carrier (17) with S26 lubricant as specified in LUBRICATION (SEC. 13). Referring to figure 62 for position of parts, place carrier on shaft, then position main bearing retainer over bearing. Install retainer to carrier with four bolts (23) and lock washers (22). Tighten bolts firmly.

4. Place carrier (17) with shaft (20) into clutch housing. With compressor drive end mounting in position attach bracket and carrier to housing with four bolts (15) and lock washers (16). Tighten bolts loosely at this time.

5. Pack ball stud socket of clutch release fork (7) with wheel bearing grease, then insert ball stud (9) into socket. Secure stud with retainer spring (8). Make sure ends of spring are located into fork.

6. Slide clutch release bearing (11) over main bearing retainer position as shown in sectional view of figure 62.

7. Install clutch release fork (7) to clutch housing, using new external lock washer (10) on ball stud. Tighten stud firmly. Figure 65 shows assembly built up.

CLUTCH HOUSING AND SHAFT INSTALLATION

NOTE: Key numbers in text refer to figure 62.

1. Install three condenser fan pump drive belts over pulley grooves of compressor flywheel (fig. 69). If pump is installed, place belts over pump pulley also. Make sure each belt is in respective pulley groove.

2. Make sure three shipping blocks shown in figure 68 are removed if a new clutch cover and member assembly is to be installed.

3. Position clutch housing assembly to compressor, then install seven attaching bolts with flat and lock washers. Tighten bolts to 20 foot-pounds torque.

4. Using same number of shims previously removed from between mounting bracket and bulkhead, attach right side of compressor drive end mounting bracket to bulkhead bracket with two bolts, nuts, and washers. Tighten bolt nuts loosely at this time.

5. Install four bolts, nuts, and washers attaching compressor drive end mounting bracket to bulkhead. IMPORTANT: Before tightening bolt nuts, locate mounting bracket to the position scribed or marked on bulkhead. Positioning of bracket as such will assure original alignment of compressor with engine accessory drive output shaft. If no lines or marks were made at bulkhead and bracket prior to removal, make alignment check as described previously under "Compressor Replacement." See "Compressor Installation."

6. Final tighten four bolts firmly which attach compressor drive end mounting bracket assembly to clutch housing.

NOTE: The number of shims required between the upper and lower half of compressor drive end mounting bracket is the number required to position mounting at a true vertical position when all attaching bolts (both those at bulkhead and the four at clutch shaft bearing carrier are final tightened. Add or remove shims as necessary, however if this is done the compressor will have to be re-aligned with engine accessory drive shaft as explained previously under "Compressor Replacement." See "Compressor Installation."

7. Install clutch control air cylinder to compressor unit making sure air strainer on cylinder is pointing slightly downward, then make clutch operating adjustment as described previously under

"Compressor Clutch Release Fork Adjustment." Push rod yoke pin at release fork is retained by a flat rubber washer and a rubber O-ring. Inset on figure 60 shows pin installation. Lubricate pivot pin end of air cylinder and release fork pin with a small quantity of multi-purpose grease.

8. Install compressor drive propeller shaft assembly as directed previously under "Compressor Drive Propeller Shaft."

9. Adjust condenser fan drive pump belt tension as explained previously under "Fan Drive Maintenance."

10. Install exhaust pipe and muffler.

11. Install fan blade to engine.

12. Install stone shields below compressor and engine.

CLUTCH CONTROL AIR CYLINDER

Clutch control air cylinder (fig. 70), pivot-mounted to side of compressor is employed to engage and disengage the compressor clutch. When cylinder push rod is retracted by air pressure supplied by the control air solenoid valve, clutch becomes engaged. When solenoid valve closes, exhausting air supply to cylinder, springs within cylinder extend the push rod to cause clutch to become disengaged.

Air, which is drawn into vented end of air cylinder when clutch is disengaged, enters through an air strainer assembly, mounted to pivot end of cylinder. Air strainer should be removed and cleaned after every three months of operation or more often if subject to extreme dusty conditions.

AIR CYLINDER REMOVAL

1. Disconnect air supply line at air cylinder, then apply shop air pressure to cylinder.

2. Remove rubber O-ring, and rubber flat washer at lower end of cylinder push rod yoke pin. Remove pin from yoke and clutch release fork. Carefully lower cylinder from compressor.

3. Remove pin which attaches pivot-end of cylinder to compressor bracket.

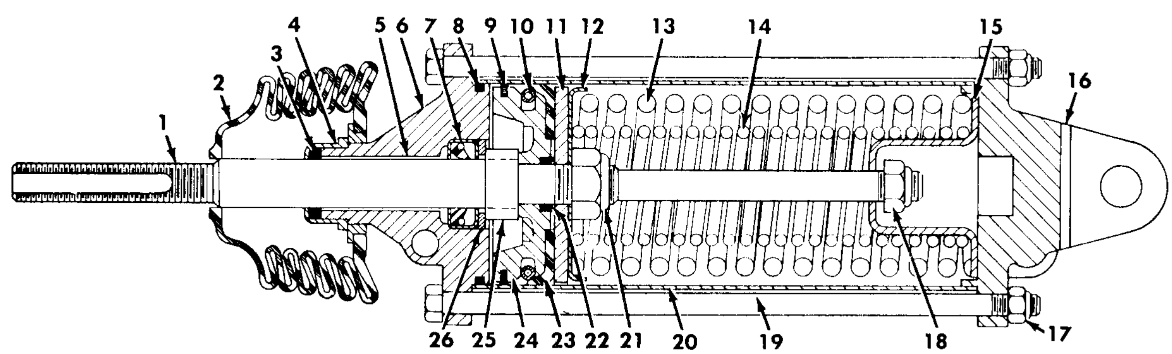
4. If necessary, remove air strainer assembly from end cover of cylinder. Instructions for cleaning air strainer are explained later under "Cylinder Air Strainer."

AIR CYLINDER INSTALLATION

1. Apply small quantity of lubricant (1/2 oz. Multi-Purpose Grease) to pivot end of cylinder and to yoke at push rod end of cylinder.

2. Raise cylinder assembly into position. Attach pivot end to mounting bracket with pin.

3. Connect shop air supply line to air cylinder.



1 Push Rod	10 Expander Spring	19 Bolt
2 Push Rod Boot	11 Piston Plate	20 Cylinder Tube
3 Seal	12 Spring Retainer	21 Push Rod Nut
4 Seal Cap	13 Spring (Large Diameter)	22 O-Ring
5 Push Rod Bushing	14 Spring (Small Diameter)	23 Piston Cup
6 Front Cover Assembly	15 Spring Retainer Cup	24 Piston Follower
7 Push Rod Seal Assembly	16 Rear Cover	25 Spacer
8 Tube O-Ring	17 Nut	26 Seal Washer
9 Piston Felt	18 Push Rod Nut	

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Figure 70—Compressor Clutch Control Air Cylinder Assembly

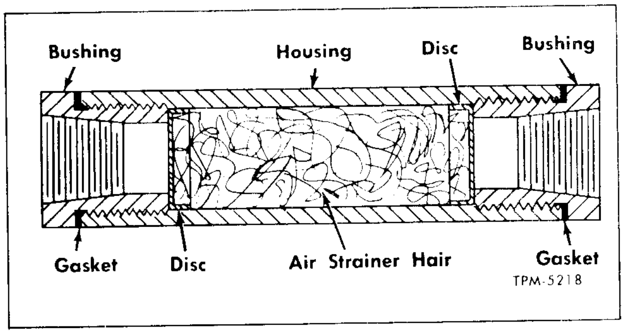


Figure 71—Air Cylinder Air Strainer

4. Check and adjust clutch control as explained previously under "Clutch Release Adjustment."

5. After proper adjustment is obtained make certain that flat rubber washer and rubber O-ring are installed to lower end of push rod yoke pin. See inset on figure 60. Connect air cylinder air line.

CYLINDER OVERHAUL

DISASSEMBLY

NOTE: Key numbers in text refer to figure 70.

1. Mark cylinder front cover (6), cylinder tube (20), and rear cover (16) so as to assure proper alignment when assembled later.
2. Remove boot (2) from push rod and front cover.
3. Remove nut (17) from ends of four bolts (19) retaining cylinder assembly together. Remove bolts.
4. Separate front cover (6) with push rod and springs from cylinder tube and rear cover. Slide front cover (6) from push rod being careful not to damage push rod seal (7).
5. Remove O-ring (8) from groove of front cover.

NOTE: At this point of disassembly the condition of piston components can be checked. To disassemble piston components, an arbor press having sufficient travel is necessary for compressing springs to allow removal of inner push rod nut (18).

CAUTION

DO NOT ATTEMPT TO DISASSEMBLE OR ASSEMBLE SPRINGS WITHOUT PROPER EQUIPMENT AS SERIOUS INJURY COULD RESULT.

6. Using arbor press with a suitable fixture that will prevent the springs from "snaking" out of position, remove push rod nut (18). Carefully back off arbor press to remove tension on springs. Remove spring retainer cup (15) and springs.
7. Remove push rod nut (21), then remove spring retainer (12), piston plate (11), piston cup (23), expander spring (10) and piston felt (9).
8. O-ring (22) can be removed from piston follower (24).
9. Slide spacer (25) from push rod.
10. If necessary, seal washer (26) and seal assembly (7) can be removed from front cover (6).

CLEANING AND INSPECTION

Clean all parts thoroughly, then inspect cylinder tube (20) and piston cup (23).

ASSEMBLY

NOTE: Key numbers in text refer to figure 70. Refer to this view for positioning of parts when assembling unit.

1. Install new seal assembly (7) into front cover (6). Install seal washer (26). Stake washer in four places.
2. Slide small diameter end of push rod (1) into boot end of front cover (6) and through seal.
3. Place spacer (25) into position on push rod.
4. Place piston follower (24) on push rod, then install small O-ring (22) into recess of follower.
5. Referring to figure 70 for proper positioning of parts, install piston felt (9) and expander spring (10) into grooves of follower (24), install piston cup (23), piston plate (11), spring retainer (12) and new push rod nut (25). Tighten nut firmly.
6. Place push rod and front cover in arbor press fixture, then place springs (13 and 14) into position. Carefully press spring retainer cup (15) over end of push rod to allow installation of new push rod nut (18). Tighten nut firmly.
7. Locate tube O-ring (8) into groove of front cover.
8. Coat inside of cylinder tube (20) with Lubriplate, then place tube over springs to front cover. Locate rear cover (16) to tube. Align marks on tube and covers which were made prior to disassembly. Install four bolts (19) and nuts (17). Tighten nuts evenly.
9. If previously removed, install seal (3) and seal cap (4).
10. Apply small quantity of clean grease to push rod, then install push rod boot (2) to front cover.

CYLINDER AIR STRAINER

Air strainer (fig. 71), installed at pivot end of air cylinder, should be removed and cleaned after every three months of operation or more often if subject to extreme dusty conditions.

Soak strainer material in cleaning solution, then flush strainer. Allow material to dry, then assemble strainer. Replace gaskets if necessary. Tighten end bushings firmly. Install strainer to air cylinder.

COMPRESSOR ACCESSORY DRIVE

The accessory drive, as used to transfer power of coach engine to operate the air conditioning refrigerant compressor, consists of a bevel drive gear and pinion enclosed within engine fan drive housing, as shown in figure 72.

Referring to figure 72, engine torque is transferred from fan drive pinion (14) to the bevel gear (13) at a ratio of 1.59 to 1.

Bevel gear (13, fig. 72) is supported in bearing retainer (4, fig. 72) on two taper roller bearings which are lubricated by engine oil pressure through internal drilled passages. Bearing retainers (4 and 21, fig. 72) of both gears can be .001" press fit or .001" loose fit in opening of accessory drive housing (20, fig. 72).

BEVEL GEAR AND PINION ARE USED IN MATCHED SETS ONLY.

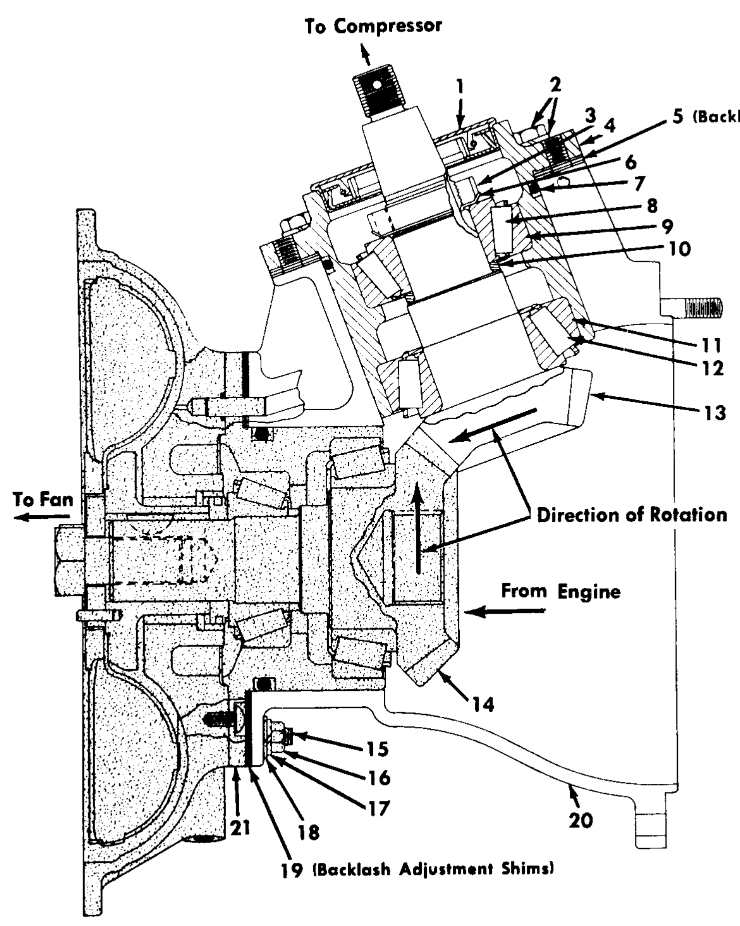
Adjustment of gear backlash and tooth contact is accomplished by removing or adding shims (5 and 19, fig. 72) which relocate position of one gear in relation to the other. Instructions for making adjustments are explained later under "Bevel Gear and Pinion Adjustments."

The following information applies to removal, disassembly, cleaning and inspection, assembly and installation of the bevel gear and bearing retainer unit only. For information on fan drive bevel pinion and bearing retainer unit, refer to Diesel Engine Maintenance Manual X-6110.

BEVEL GEAR AND BEARING RETAINER REMOVAL

NOTE: Key numbers in text refer to figure 72.

1. Remove nut which attaches propeller shaft flange to drive gear (13). Remove flange and key.



1 Oil Seal Assy.
2 Bearing Retainer Attaching Bolts and Lock Washers
3 Bearing Adjustment Nut
4 Bearing Retainer
5 Backlash Adjustment Shims
6 Adjustment Nut Lock
7 Bearing Retainer O-ring Seal
8 Outer Bearing Cone Assy.
9 Outer Bearing Cup
10 Bearing Adjustment Spacer (Variable Thickness)
11 Inner Bearing Cup
12 Inner Bearing Cone Assy.
13 Bevel Gear
14 Bevel Pinion with Bearing Retainer and Fan Drive Unit
15 Stud
16 Nut
17 Lock Washer
18 Flat Washer
19 Backlash Adjustment Shims
20 Accessory Drive Housing
21 Fan Drive Bearing Retainer

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Figure 72—Compressor Accessory Drive

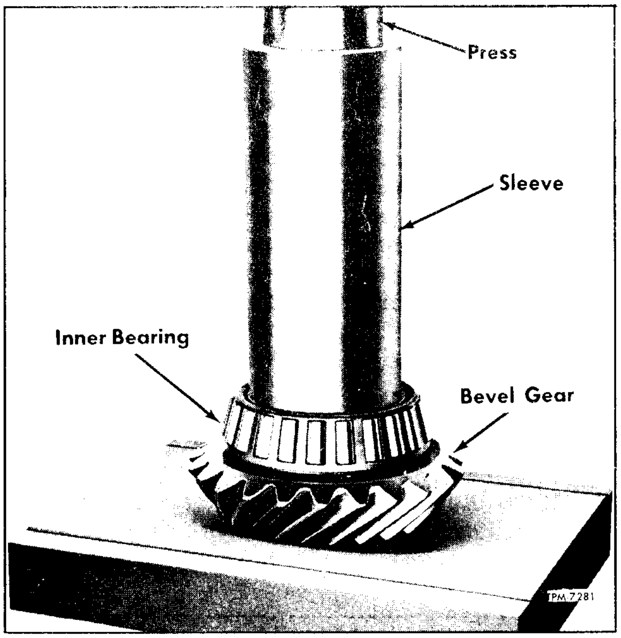


Figure 73—Installing Bevel Gear Inner Bearing

2. Mark position of bearing retainer (4) in relation to accessory drive housing to assure original position when assembled later.

3. Install two puller screws into tapped holes in bearing retainer (4) and force bearing retainer evenly from housing. Remove puller screws. Retain shim pack (5) to assure original gear backlash if it was found satisfactory.

4. Disassemble bevel gear and retainer unit as explained later under "Bevel Gear and Bearing Retainer Disassembly."

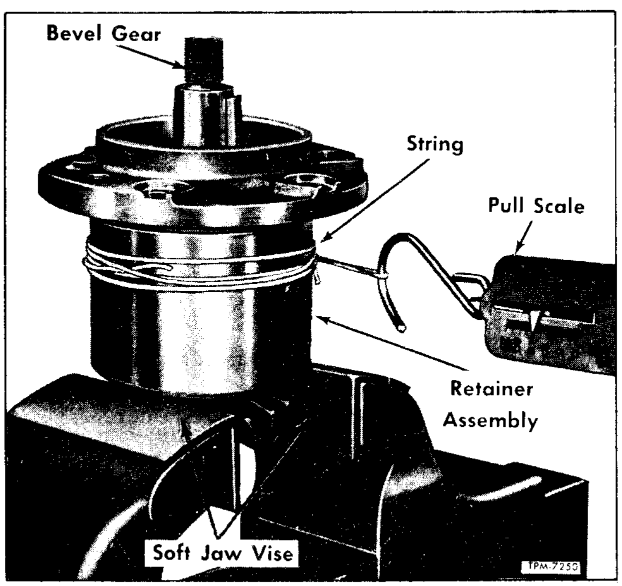


Figure 74—Checking Bevel Gear Bearing Adjustment

BEVEL GEAR AND BEARING RETAINER DISASSEMBLY

NOTE: Key numbers in text refer to figure 72.

1. Remove O-ring seal (7) from groove in bearing retainer.

2. Using sharp bladed tool, pry oil seal assembly (1) from bearing retainer.

3. Bend down tab of adjustment nut lock (6).

4. Position bevel gear assembly in a vise having soft jaws; then using a suitable spanner wrench, remove adjustment nut (3). Remove nut lock (6).

5. Support bevel gear retainer (4) in an arbor press and force bevel gear (13) with inner bearing cone (12) and bearing adjustment spacer (10) from retainer. Remove spacer (10) from shaft. If inner bearing needs replacement, remove bearing using arbor press and remover plates.

6. Remove outer bearing cone assembly (8) from retainer.

7. If necessary, bearing cups (9 and 11) can be removed from retainer, using suitable equipment.

CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent. Wipe or blow parts dry.

2. Inspect rollers of bearing cones for nicks and worn spots. Inspect bearing cups also for indication of wear. Replace cones and cups if not in good condition. After cleaning and inspection of bearing parts, lubricate parts generously with clean engine oil, then wrap in clean lint-free cloth or paper until ready to install.

3. Check teeth of bevel gear for poor teeth contact pattern, nicks, or worn condition. NOTE: Bevel gear and pinion are serviced in matched set only.

ASSEMBLY OF BEVEL GEAR AND BEARING RETAINER

NOTE: Key numbers in text refer to figure 72. Coat all parts in clean SAE 30 engine lubricant when assembling unit.

1. If bevel gear inner bearing cone (12) was removed from bevel gear at disassembly, install inner bearing cone using a suitable sleeve and arbor press. Support bevel gear on soft metal or hardwood block and seat bearing race firmly at shoulder (fig. 73).

2. Install bearing adjustment spacer (10) on shaft of bevel gear.

3. Inspect counterbores in bearing retainer (4) which must be clean.

4. Use a suitable driver and arbor press and install bearing cups (9 and 11) in retainer.

5. Apply engine lubricant on bearing assem-

blies; then set the retainer in place on bevel gear.

6. Install outer bearing cone (8), adjustment nut lock (6) and adjustment nut (3). NOTE: Care should be taken to prevent nut lock from turning with adjustment nut.

7. Support teeth of bevel gear in a soft jaw vice; then adjust gear bearing preload as follows:

a. Wrap a heavy cord around bearing retainer and attach a spring scale as shown in figure 74.

b. Use a deep spanner wrench to tighten bearing adjustment nut (3) to 175 to 200 foot-pounds torque. Rotate bearing retainer by pulling on spring scale. Correct bearing preload will require a 4-1/2 to 9-1/2 lbs. pull to rotate retainer. If necessary, replace bearing adjustment spacer (10) with another size.

Spacers are available in thicknesses shown in chart following:

BEARING SPACER CHART

GM Part No.	Thickness	Stamped
2389880	.224"-.223"	P-24
2397019	.2225"-.2215"	P-225
2389879	.221"-.220"	P-21
2397018	.2195"-.2185"	P-195
2389878	.218"-.217"	P-18
2397017	.2165"-.2155"	P-165
2389877	.215"-.214"	P-15
2397016	.2135"-.2125"	P-135
2389876	.212"-.211"	P-12
2397015	.2105"-.2095"	P-105
2389875	.209"-.208"	P-09
2397014	.2075"-.2065"	P-075
2389874	.206"-.205"	P-06
2397013	.2045"-.2035"	P-045
2389873	.203"-.202"	P-03
2397012	.2015"-.2005"	P-015
2386043	.200"-.199"	P-00
2397011	.1985"-.1975"	P-985
2389872	.197"-.196"	P-97

c. When correct adjustment is obtained, lock adjustment nut by bending up tab of adjustment nut lock (6).

8. Apply seal cement to outer diameter of seal (1), then press seal evenly into retainer.

9. Install propeller shaft flange shaft and key. Tighten flange nut to 140 foot-pounds torque.

10. Locate new O-ring seal (7) into groove of retainer (4).

BEVEL GEAR AND BEARING RETAINER INSTALLATION

Key numbers in text refer to figure 72.

NOTE: To facilitate installation, the gear and retainer unit can be cooled and the accessory drive housing can be heated.

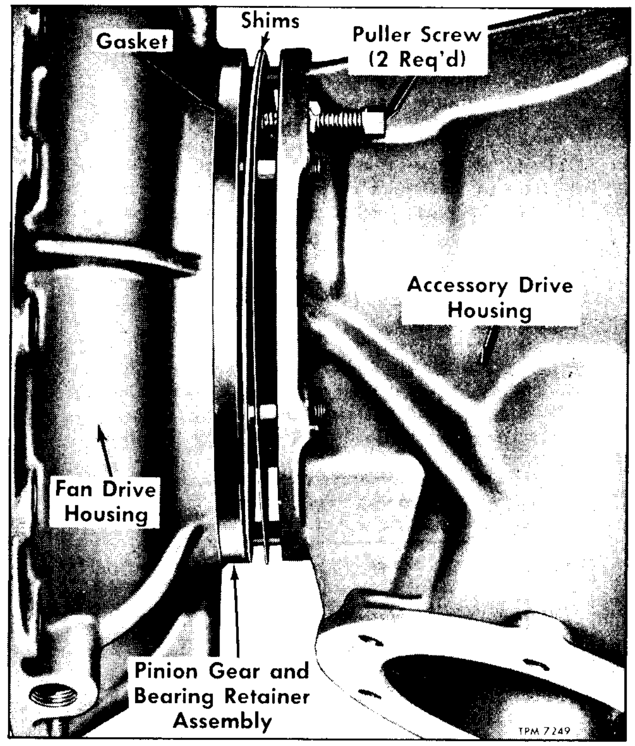


Figure 75—Shims Installed Between Drive Housing and Pinion Gear Retainer

CAUTION: IF IT IS FOUND NECESSARY TO HEAT THE ACCESSORY DRIVE HOUSING, APPLY HEAT UNIFORMLY TO HOUSING, OTHERWISE THE CASTING MAY FRACTURE. HEAT LAMPS HAVE BEEN FOUND SATISFACTORY FOR THIS PURPOSE.

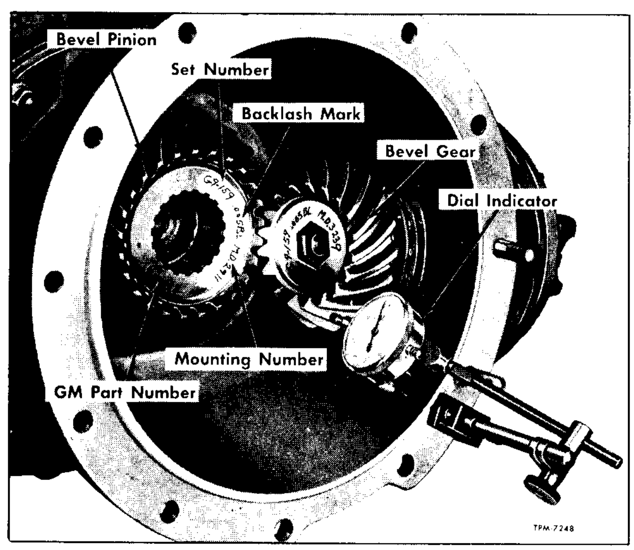


Figure 76—Checking Bevel Gear Backlash

AIR CONDITIONING

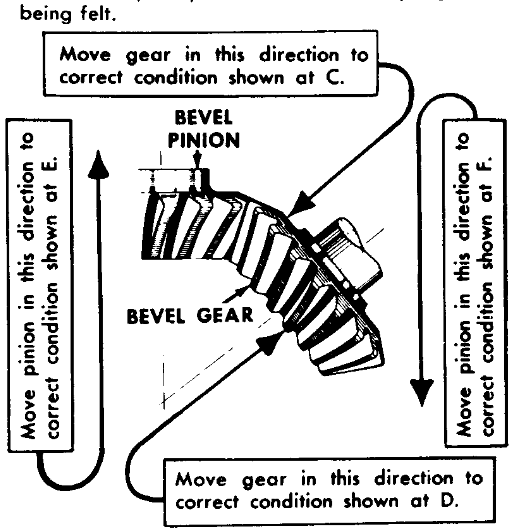
INSTRUCTIONS

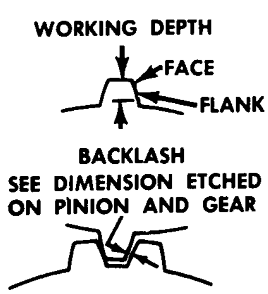
1—Install bevel pinion and bevel gear assemblies; then adjust pinion and bevel gear for proper backlash as directed in "Bevel Gear and Pinion Adjustments" paragraph of this section.

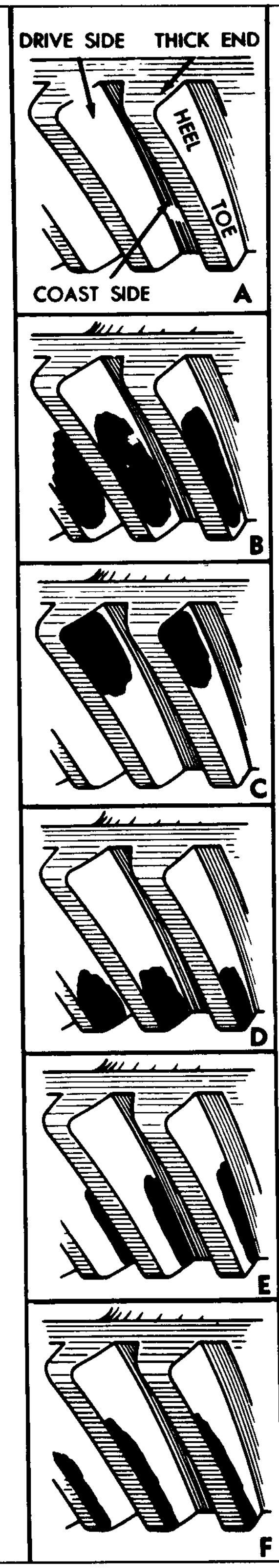
2—Paint three or four teeth of bevel gear with red lead or mechanics blue and rotate bevel gear in direction of rotation until pinion makes complete revolution.

3—Note area of tooth contact which should start at toe and extend about 80 percent of tooth length toward heel, as at B.

4—Vary position of pinion and gear as per chart until proper tooth contact is obtained. Be sure that sufficient backlash has been allowed so that gear can be completely revolved without any highspots being felt.







A—Check adjustments at drive side of BEVEL GEAR tooth

B—Shows correct tooth contact

NOTE: Key Numbers Below Refer to Figure 72.

C—Shows short contact at heel. To correct, decrease shim thickness (5) to move gear toward pinion. Then increase shim thickness (19) to move pinion away from gear to again secure correct backlash.

D—Shows short contact at toe. To correct, increase shim thickness (5) to move gear away from pinion. Then decrease shim thickness (19) to secure correct backlash.

E—Shows heavy contact on flank or lower portion of tooth. To correct, increase shim thickness (19) to move pinion away from gear until contact comes to full working depth of gear tooth without breaking contact at flank. Then decrease shim thickness (5) to move gear toward pinion to secure correct backlash.

F—Shows heavy contact on face or upper portion of tooth. To correct, decrease shim thickness (19) to move pinion toward gear until contact covers flank of tooth without breaking contact at face. Then increase shim thickness (5) to move gear away from pinion to secure correct backlash.

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Figure 77—Accessory Drive Bevel Gear and Pinion Tooth Contact Chart

1. Apply clean engine lubricant to outer surface of bearing retainer (4) and over O-ring seal (7) installed in groove of retainer.

2. Locate same pack of adjustment shims (5) removed originally over retainer (4), then with marks made on retainer and housing prior to disassembly in alignment, insert bearing retainer into accessory drive housing (20).

3. Use two long bolts, opposing each other to pull retainer into housing, then install bolts and lock washers (2) attaching bearing retainer to accessory drive housing. Tighten bolts evenly and firmly.

4. If propeller shaft flange was not installed previously, install flange with drive key to bevel gear. Tighten flange nut 100 to 110 foot-pounds torque.

BEVEL GEAR AND PINION ADJUSTMENTS

NOTE: Key numbers in text refer to figure 72.

Shims (5 and 19) are available in three thicknesses (0.003", 0.010", and 0.031") for adjustment of backlash and tooth contact of bevel pinion and bevel gear. Figure 75 shows shims installed between accessory drive housing and pinion gear retainer. Whenever assembling accessory drive unit or installing new pinion and bevel gear, or in event it should become necessary to readjust gear backlash because of normal wear, the following operations must be accomplished to properly adjust the pinion and bevel gear backlash.

Backlash dimension is etched on pinion and bevel gear as shown in figure 76.

1. If accessory drive housing is installed to coach engine it must be removed as directed under "Cooling System" in 8V-71 Diesel Engine Maintenance Manual X-6110.

2. Check gear backlash using dial indicator positioned as shown in figure 76. Dimension should be same as etched on gears. Adjustment can be accomplished through shims (5 and 19) provided between bevel gear bearing retainer (4) and accessory drive housing (20), and between bevel pinion bearing retainer (21) and accessory drive housing (20). Shims are of 0.003", 0.010" and 0.031" thickness.

3. To check for proper tooth contact, paint several teeth on pinion gear with a mixture of ground red lead and engine oil, or a similar marking compound, to provide a method of determining tooth contact.

4. Turn bevel pinion in direction of rotation (fig. 72) and observe tooth contact impression on drive side of gear teeth. Contact should start at toe of tooth (view B, fig. 77) and extend back about 80% of tooth length toward heel. Contact should be distributed evenly over flank and face of tooth, indicating center of contact on pitch line. Refer to views "A" and "B," figure 77.

a. If tooth contact is too far out on tooth toward heel (view C, fig. 77), decrease thickness of shim pack (5) between bevel gear bearing retainer (4) and accessory drive housing (20), moving bevel gear toward pinion. Restore backlash by increasing shim thickness (19) between pinion bearing retainer (21) and accessory drive housing (20). Figure 75 shows shims (19) installed between pinion gear bearing retainer and accessory drive housing. This view also shows puller screws used for removing bearing retainer from accessory drive housing.

b. If tooth contact extends from toe appreciably less than 80% of tooth contact (view D, fig. 77) move bevel gear away from pinion by increasing shim thickness (5) between bevel gear bearing retainer and accessory drive housing. Restore backlash by decreasing shim thickness (19) between pinion bearing retainer and accessory drive housing.

c. If tooth contact is low on flank of tooth (view E, fig. 77), move pinion away from bevel gear by increasing shim thickness (19) between pinion bearing retainer and accessory drive housing. Restore backlash by decreasing shim thickness between bevel gear bearing retainer and accessory drive housing.

d. If contact is high on face of tooth (view F, fig. 77), move pinion toward bevel gear by decreasing shim thickness (19) between pinion bearing retainer and accessory drive housing. Restore backlash by increasing shim thickness (5) between bevel gear bearing retainer and accessory drive housing.

5. When pinion and bevel gear adjustments have been completed, make certain that all retainer attaching bolts (2) and nuts (16) are securely tightened. Recheck adjustment. Remove all red lead from gears.

6. Install accessory drive unit in coach.

System Services and Tests

CONTENTS OF THIS SECTION

NOTE: General instructions for servicing air conditioning system are located on the back side of compressor compartment door as shown in figure 78. Detail service instructions are explained in this section under respective headings.

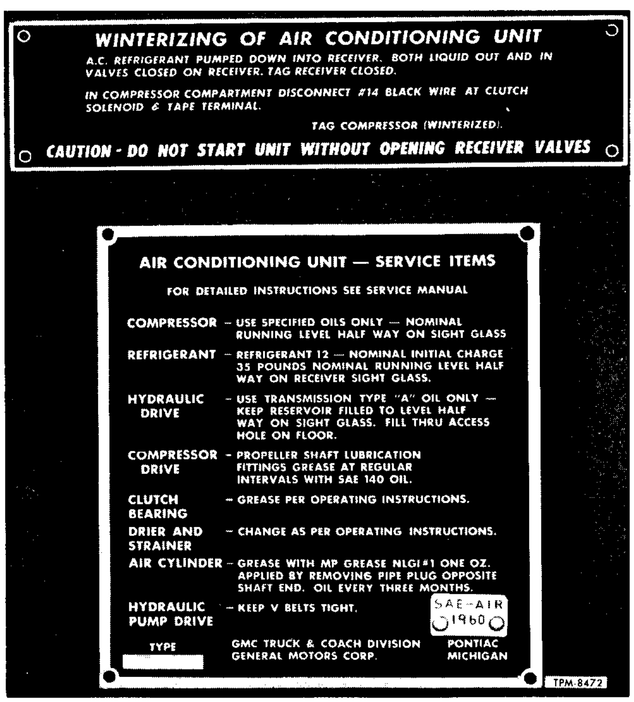


Figure 78—Service Instruction Plates—Located on Inner Side of Compressor Compartment Door

PREPARING SYSTEM FOR OPERATION

When air conditioning units have been inoperative during the off-season, certain inspection and service operations must be accomplished before system is placed back in operation.

1. Investigate for small stones which may have lodged between belts and top grooves of condenser fan drive pump.
2. Connect compressor drive propeller shaft if previously disconnected.
3. If compressor has been overhauled, make sure proper amount of oil has been replaced in compressor. Check for evidence of oil or refrigerant leakage past the compressor crankshaft seal using a leak detector. If seal leaks, remove compressor from coach and replace seal.
4. Charge compressor with refrigerant to provide internal pressure. Refer to "Charging System" later in this section.
5. Replace filter element in condenser fan fluid reservoir. Refer to "Condenser Fan Fluid Reservoir" previously for element replacement.
6. Clean condenser coil as instructed later under "Cleaning Coils of Condenser."
7. Check tension of condenser fan fluid pump drive belts. Refer to "Condenser Fan and Drive" previously.

8. Clean air filter screen in heating and cooling compartment. Also clean the evaporator coil in same compartment. Use high pressure water and air mixed being careful not to damage coil fins.

9. Connect feed wire to clutch control air solenoid valve (fig. 4).

10. Install new dehydrator-strainer unit in refrigerant system. Refer to "Replacing Dehydrator-Strainer" later.

11. Place discharge and suction valves atop compressor in operating position as explained later under "Refrigerant Valves." Open receiver valves.

12. Lubricate compressor clutch mechanism as explained previously under "Compressor Drive."

PREPARATION OF SYSTEM FOR INACTIVE SEASON

1. The system should be pumped down and all refrigerant valves closed.

2. In compressor compartment, disconnect #14 black with wire from terminal of clutch control air solenoid valve (fig. 4). Tape terminal at end of wire.

3. The compressor drive shaft rear joint assembly should also be removed and the forward slip yoke assembly should be wired securely to bulkhead as shown in figure 79. NOTE: If slip yoke is removed a substitute cap must be placed over end of clutch shaft to prevent entry of dirt. Tag unit: CAUTION AGAINST STARTING.

SERVICING CONDENSER FAN DRIVE FLUID SYSTEM

DRAINING SYSTEM

1. Remove floor access cover from over fluid reservoir in compressor compartment at rear of coach.

2. With a catch basin positioned under line connections at fluid pump in compressor compartment, slowly break connections one at a time. Allow fluid to drain into basin.

3. After draining system, reconnect lines to pump. Do not tighten connections firmly at this time.

FILLING SYSTEM

1. Remove cover from system fluid reservoir in compressor compartment.

2. Fill reservoir with recommended fluid. System requires approximately six quarts.

3. Loosen line connections at fluid pump so that lines will fill and vent with fluid. Retighten connections when all air is expelled.

4. While having assistant maintain fluid level in reservoir, start system and operate fluid pump. Run engine at fast idle speed while filling.

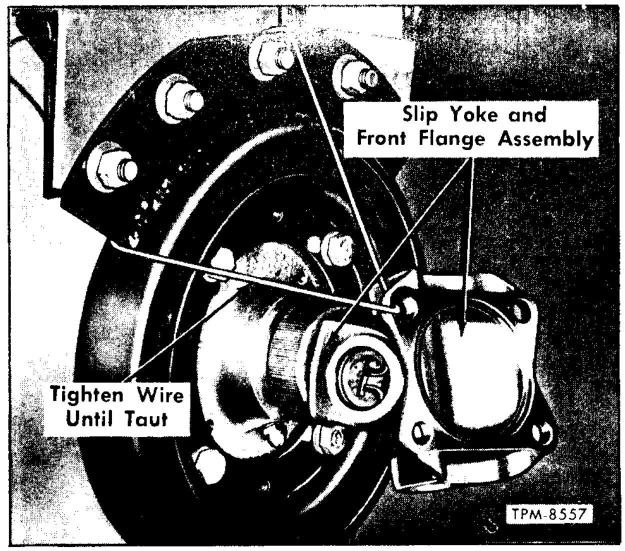


Figure 79—Compressor Drive Propeller Shaft Disconnected for Inactive Service

CAUTION: Do not operate engine without fluid in pump.

5. Make sure all air is expelled from system and reservoir is full to "OIL LEVEL" mark (fig. 80). Check for leaks at all line connections.

6. Install reservoir cover making sure large rubber seal at cover and the small rubber seal at cover nut is properly located. Hand tighten cover nut.

7. Install access cover above reservoir.

REPLACING FILTER ELEMENT

Procedure for replacing reservoir filter element is explained previously under "Condenser Fan and Drive," page 23.

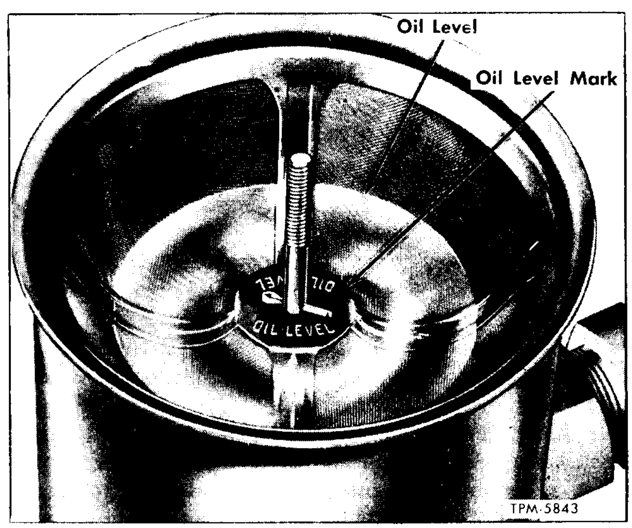


Figure 80—Oil Level in Condenser Fan Drive Fluid Reservoir

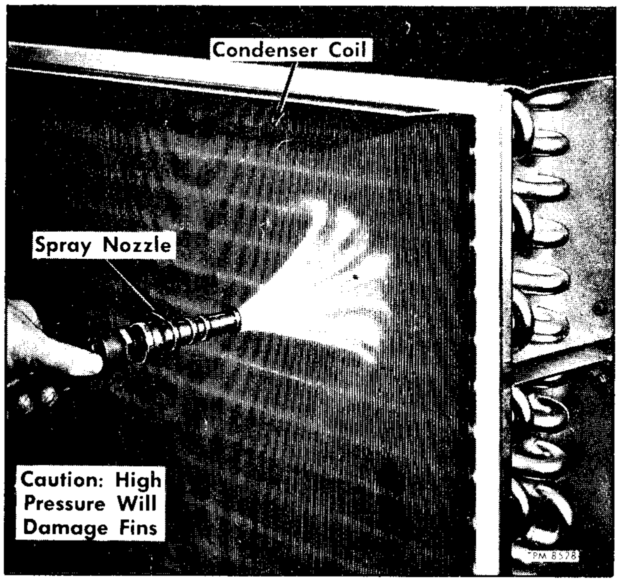


Figure 81—Cleaning Condenser Coil

CLEANING COILS OF CONDENSER

At regular coach service intervals check condenser coil external surfaces for dirt or other foreign matter. A clogged coil will cause high refrigerant pressures to provide insufficient cooling.

Referring to figure 81, flush from inner side of coil using water, or water mixed with air pressure as shown.

IMPORTANT: DIRECT PRESSURE STRAIGHT THROUGH COIL TO PREVENT BENDING OF FINS AND ALSO DO NOT USE EXTREME HIGH PRESSURE.

CHARGING THE SYSTEM

ADDING REFRIGERANT TO SYSTEM

NOTE: Before adding any refrigerant to system, make sure all leaks have been repaired. Also level out the system by operating the system for 10 to 20 minutes at approximately 1500 engine rpm.

1. Refer to figure 82, which shows lines and gauge set properly installed. Install gauge set to test gauge fittings as shown.

Connect refrigerant tank charging line loosely to center fitting of gauge manifold. Purge air from refrigerant supply line, then retighten line fitting.

2. Open valve on low pressure side of gauge manifold. Make sure valve on high pressure side is closed.

3. Open outlet valve on refrigerant tank. Support refrigerant tank in its upright position and have assistant start and operate system at approximately 1500 engine rpm. Refrigerant will be drawn into system. DO NOT FEED REFRIGERANT TO SYSTEM TOO FAST AS THIS WILL CAUSE OIL TO LEAVE COMPRESSOR. Operate system until refrigerant level in receiver tank sight glass (fig. 11) is at middle of glass. Check oil level in compressor sight glass. Coach temperature should be 85° to 90°F., during leveling off, so that all oil will return from system to compressor. Steam may be used for additional load on evaporator to hasten return of oil.

4. Close refrigerant tank outlet valve, and remove line and gauge equipment. Install protector caps on test gauge fittings at compressor valves.

CHARGING AN EMPTY SYSTEM

A system which has been evacuated can be charged in same manner described above for "Adding Refrigerant to System." However, if compressor cannot be operated, refrigerant can be transferred from refrigerant tank to system as directed above until refrigerant "HI-LO" pressure switch cuts in and compressor starts to operate. Continue to add refrigerant to system by performing Steps 3 and 4 under "Adding Refrigerant to System."

REMOVING EXCESS REFRIGERANT

1. Install refrigerant gauge set to test gauge fittings. Make sure gauge valves are closed.

2. An empty or partly empty refrigerant drum should be connected with hose to center fitting of gauge set. Purge air and moisture from connecting hose.

3. Pack refrigerant drum upright in cracked or dry ice until the temperature of drum is sharply reduced and the pressure within the drum is well below the pressure in the high side of the system.

4. Making sure compressor valves are open, start compressor, then slowly open valve at top of drum. Close valve as soon as high pressure gauge indicates normal head pressure.

NOTE: If too much refrigerant was removed, bubbles will appear in refrigerant as viewed through receiver sight glass. If such is the case, remove ice and warm drum, then open drum valve, returning refrigerant to system. Recheck for bubbles and observe oil level in compressor.

5. Close valves and disconnect drum, hoses, and gauges.

PUMPING DOWN THE SYSTEM

In order to accomplish any operations on the system which necessitate disconnecting refrigerant lines, it is necessary to first pump down the system to prevent appreciable loss of refrigerant. To pump down the system means to pump most of the refrigerant into the liquid receiver tank.

1. Operate compressor for 10 or 15 minutes to permit the system to level out, then with compressor still running, close the liquid out valve on

bottom of liquid receiver tank by turning the valve stem in until the valve seats.

2. Continue to operate compressor at approximately 1600 engine rpm, until low pressure switch stops it, observing pressure on gauge.

3. When suction pressure builds up to low pressure switch cut-in (22 pounds - after approximately 5 minutes), again start compressor and run until it again cuts out.

4. Close receiver tank inlet valve and compressor valves IMMEDIATELY after system shuts off. Most of the refrigerant is now contained in the liquid receiver tank. A small amount of refrigerant in a gaseous state remains in compressor, condenser, and lines. Gas will be retained in compressor unless valves are opened. The small amount remaining in condenser and refrigerant lines will be lost when lines are disconnected.

IMPORTANT: If lines to be opened to atmosphere are colder than the ambient air temperature, a considerable amount of sweating will take place on inside of lines. ALWAYS ALLOW REFRIGERANT PIPING AND UNITS TO WARM UP TO THE AMBIENT AIR TEMPERATURE BEFORE OPENING SYSTEM.

5. In the event low pressure side only of system is to be opened for a short period of time, refrigerant need not be pumped down completely into receiver tank. Leave the receiver tank inlet valve open and close the compressor discharge valve. This will retain refrigerant in the tank, the condenser, and in the high pressure line to compressor. Later it will be necessary to pull a vacuum on the isolated low pressure side of system only.

EVACUATING THE SYSTEM

Evacuating the system means to place a vacuum on the refrigerant system for the purpose of removing air and moisture. Moisture in system can cause either freezing at the expansion valve or a formation of an acid which is definitely detrimental to the internal parts of compressor. Air in system will cause high head pressure and reduce the cooling capacity.

Whenever the refrigerant system has been opened to a point where moisture and air has been admitted, it is necessary to thoroughly evacuate the system BEFORE RECHARGING.

In case of emergency, where a vacuum pump is not available, system may be blown out with refrigerant to eliminate air in system. This should only be done in an emergency, since considerable refrigerant is used; also a reliable vacuum pump, capable of pulling 28 to 29 inches of vacuum will do a more satisfactory job.

Three different conditions could exist which would determine the method for evacuating the system using a vacuum pump:

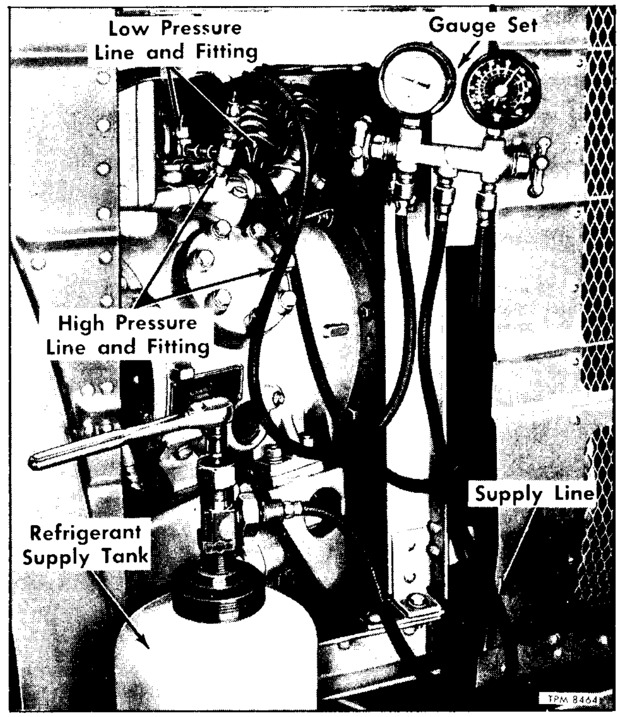


Figure 82—Charging Refrigerant System

1. A condition where an empty system, having no refrigerant at all has been exposed to air and moisture for an extended period of time.

2. A condition where a system in operation has been pumped down with all the refrigerant contained within the receiver tank. This condition could exist if either the high or low pressure side or both sides of system were opened, or exposed.

3. A condition where all the refrigerant has been pumped down only to a point where it is contained in the high pressure side of system such as in the receiver tank, the condenser coil and in the line to the compressor discharge valve. This procedure may be performed at any time when the low pressure side of system has been opened for a short period of time, such as when replacing the evaporator coil or any other unit in the low pressure side of system.

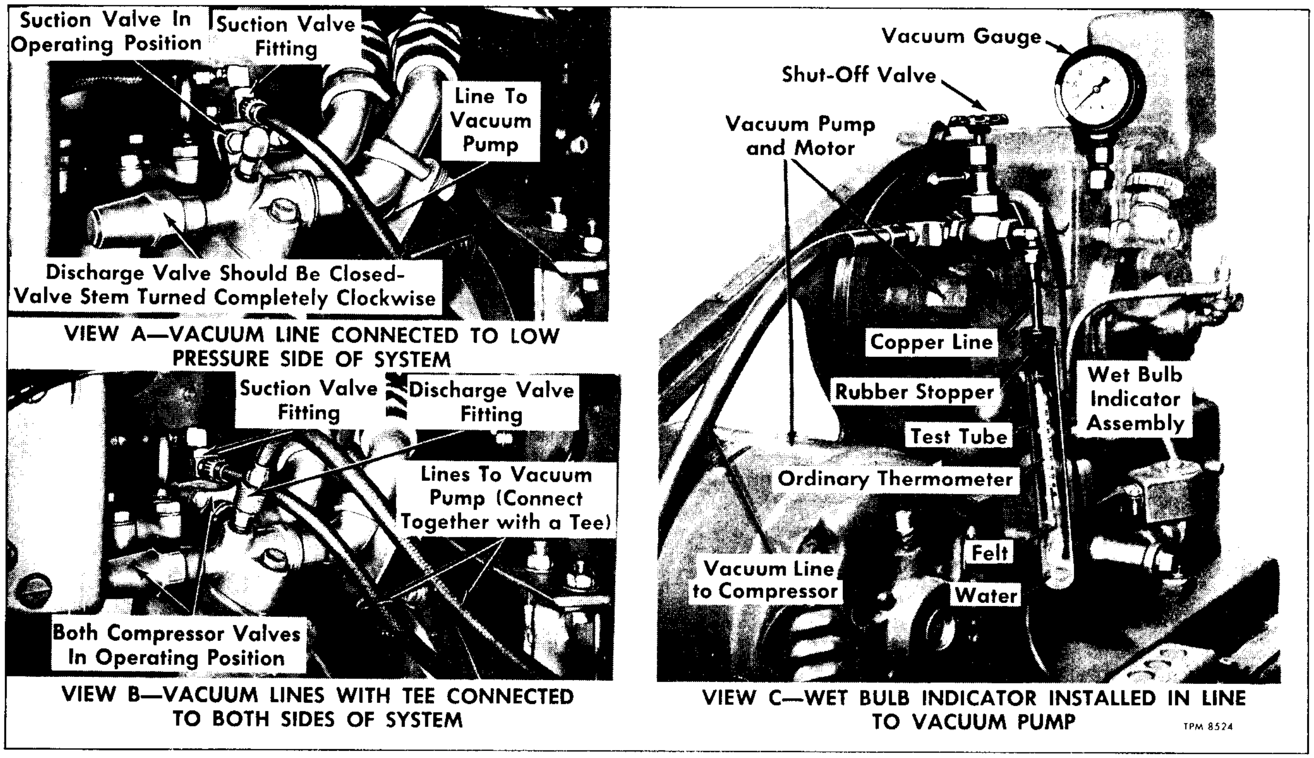
When evacuating system later, only the low pressure side of system need be exposed to vacuum.

TO EVACUATE AN EMPTY SYSTEM

1. Using a tee in vacuum line, arrange two vacuum lines from vacuum pump to compressor.

2. Connect one vacuum line to test gauge fitting at top of compressor suction valve, and the other to the compressor discharge valve test gauge fitting as shown in view B, figure 83.

3. Tee a branch line with a wet bulb indicator into vacuum line at pump as shown in view C, figure 83. NOTE: Wet bulb indicator can be impro-



VIEW A—VACUUM LINE CONNECTED TO LOW PRESSURE SIDE OF SYSTEM

VIEW B—VACUUM LINES WITH TEE CONNECTED TO BOTH SIDES OF SYSTEM

VIEW C—WET BULB INDICATOR INSTALLED IN LINE TO VACUUM PUMP

Figure 83—Evacuating the Refrigerant System

vised from a test tube, a short line, a rubber stopper, a narrow piece of felt (2 in. long) and an ordinary house thermometer.

4. Place all valves (two at receiver tank and two at compressor) in operating position.

5. Operate vacuum pump to give maximum vacuum (28 to 29 in.) for at least two hours or until temperature reading on thermometer within indicator registers 35°F. NOTE: Open shut-off valve in branch line to indicator only to read indicator; otherwise keep valve closed during evacuating period.

6. Back-seat compressor valves, then disconnect vacuum pump lines from compressor fittings. Install protector caps over fittings. Place compressor valves in operating position. System is now ready to be charged.

TO EVACUATE AFTER SYSTEM HAS BEEN PUMPED DOWN (All Refrigerant Contained in the Receiver Tank)

NOTE: When system has been pumped down into receiver tank, both the inlet and outlet valves at tank will be closed.

1. Connect same vacuum pump arrangement previously described "To Evacuate An Empty System" (see Steps 1, 2, and 3).

2. Place both the discharge and suction valves at compressor in operating position.

3. Pull a vacuum on exposed or open system as directed previously in Step 5 under "To Evacuate An Empty System."

4. After evacuating system, back-seat compressor valves, then disconnect vacuum lines. Install protector caps on fittings, then place compressor valves in operating position.

TO EVACUATE AFTER SYSTEM HAS BEEN PUMPED DOWN (Refrigerant Contained in the High Pressure Side of System Only)

NOTE: When system was pumped down into the high pressure side of system, the receiver tank outlet valve only was closed and the compressor discharge valve only was closed. Refrigerant is now contained in the receiver tank, the condenser coil, and in the high pressure line to compressor discharge valve.

Evacuate as follows:

1. Connect only one vacuum pump line to the test gauge fitting at top of compressor suction valve as shown in view A, figure 83.

2. Use same vacuum pump and wet bulb arrangement described previously under "To Evacuate An Empty System" (see Step 3).

3. Making sure that compressor suction valve is in operating position, evacuate low pressure side of system in same manner as directed previously under "To Evacuate An Empty System" (see Step 5).

4. After complete evacuation of system, back-

seat compressor suction valve, then disconnect vacuum line. Install protector cap on valve fitting.

5. Place all refrigerant valves (two at receiver tank and two at compressor) in operating position.

CHECKING FOR AIR IN SYSTEM

Air in refrigerating system causes excessive head pressures and reduction in cooling capacity. Check for air in system as follows:

1. Connect an accurate pressure gauge to high pressure test gauge fitting at compressor discharge valve.
2. Hang an accurate thermometer in condenser compartment between condenser coil and receiver tank.
3. Allow compressor to stand idle for several hours to allow temperatures of all parts to equalize, then note reading on thermometer and reading on gauge.
4. Compare this figure with figures shown in pressure-temperature chart on page 18 in this section. If pressure gauge shows a reading of more than 3 pounds higher than pressure shown on chart for the existing temperature, air must be purged from system.

PURGING AIR FROM SYSTEM

Whenever system has been pumped down or evacuated and system has been opened, or if operating difficulties indicate air in the system, purge air from system after all parts of system reach the same temperatures as follows:

1. Place refrigerant valves in "Operating Position," to admit refrigerant to entire system.
2. To purge air from liquid receiver tank loosen fusible safety plug in top of receiver tank (fig. 11). Tighten plug after a small amount of refrigerant gas has escaped.
3. To purge evaporator, loosen external equalizer tube fitting at expansion valve, permit a small amount of gas to escape, then tighten fitting.
4. If a large amount of air is indicated, it may be necessary to pump the refrigerant into a refrigerant supply tank and purge the air from the tank. To accomplish this, connect line from refrigerant supply tank to high pressure test gauge fitting at compressor discharge valve. While cooling the refrigerant supply tank with cold water or ice, run compressor to pump the refrigerant into the tank. Continue to run compressor until low pressure switch stops it. As soon as compressor stops, close valve at refrigerant tank. Let tank stand for several hours, bleed air off top of tank, then transfer the refrigerant back into the system as directed previously under "Charging The System."

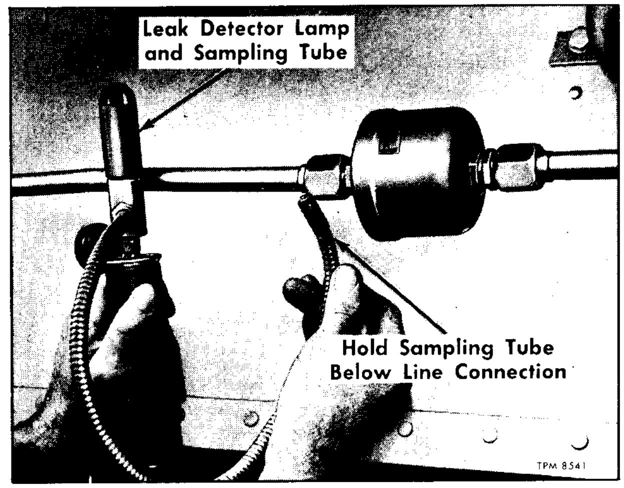


Figure 84—Testing for Refrigerant Leaks

SUPERHEAT CHECK

Instructions for checking superheat are explained previously under "Expansion Valve" in "SYSTEM MAINTENANCE" section of this group.

TESTING FOR REFRIGERANT LEAKS

Whenever repairs or adjustments have been made to any part of the refrigerating system which necessitate disconnecting refrigerant lines, connections should be tested for leakage before the system is restored to service. First admit only enough gas into the system to produce 5 or 10 pounds pressure, then test for leaks (fig. 84), using leak detector explained below. If no leaks are found at this pressure, increase pressure 5 or 10 pounds, and test for leaks again. In this way, only a slight amount of refrigerant gas will be lost in the event there is a leak. Final test should be made with system under operating pressure. Large leaks will be indicated by oil seepage and must be repaired immediately.

REFRIGERANT LEAK DETECTOR

Refrigerant leak detector, commonly called a Halide Lamp, is a small torch which burns methyl alcohol. Air used in burner is drawn through a flexible sampling tube. Operation of leak detector is as follows:

Pressure is produced in the lamp fuel tank by heat of generation at time alcohol is burned in small cup under burner. Observe color of flame when clear air is being drawn through the sampling tube. Color of flame may vary depending on type and grade of alcohol used in burner.

By holding open end of sampling tube under connections, joints, valves, etc. (fig. 84), any traces of refrigerant would be drawn through the

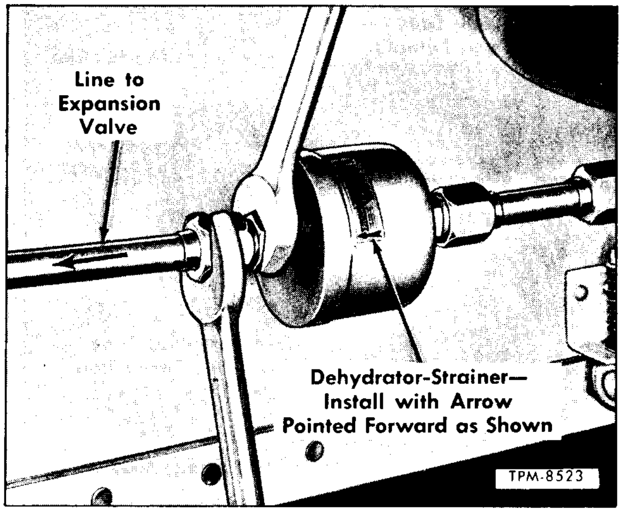


Figure 85—Replacing Dehydrator-Strainer

tube to the burner and would be immediately evident by the change in color of the flame. Refrigerant breaks down when coming in contact with the heated copper ring in burner and changes the color of the flame. Do not confuse change in color with change caused by shutting off air supply in holding end of sampling tube too close to some object.

NOTE: Compressor crankshaft seal can be checked for leakage by inserting end of detector tube into hole at bottom of clutch housing when compressor is not operating.

Instructions are supplied with leak detector and should be carefully studied. Only high grade Anhydrous Methyl Alcohol as listed under "Equipment and Material" at end of this group should be used in burner.

Leak detectors which burn acetylene gas are also available and may be used.

When refrigerant has been lost, adding refrigerant without knowing cause or location of leak merely postpones corrective measures and increases maintenance costs. At two or three week intervals, go over entire system with leak detector. Check for leaks at all joints and connections throughout the system.

REPLACING DEHYDRATOR—STRAINER

1. Pump down the system as explained previously.
2. Referring to figure 85, remove old unit in manner shown. CAUTION: Do not twist refrigerant lines, use two wrenches as shown.
3. Remove old unit from refrigerant line, then remove sealing caps from new unit and IMMEDIATELY thread unit into liquid line. Tighten connections firmly.
4. Open liquid receiver valves and compressor valves before placing the unit in operation. With system operating, test for leaks at connections, using a Halide Torch. Refer to "Testing For Leaks" explained previously.

REFRIGERANT VALVES

Before operating air conditioning system after storage or inactive period and during operation of system, refrigerant valves must be in "Operating Position." When system has been pumped down and is being prepared for operation, open valves in the following sequence:

1. Receiver Tank Liquid Out Valve - Fully Open.
2. Compressor Suction Valve - Refer to "SYSTEM MAINTENANCE" previously in this group.
3. Compressor Discharge Valve - Refer to "SYSTEM MAINTENANCE" previously in this group.
4. Receiver Tank Inlet Valve - Fully Open.

SERVICING COMPRESSOR OIL CHARGE

The initial charge of oil in the compressor is 4 pints. Oil level in compressor is observed through sight glass at side of compressor. Oil level should be checked immediately after system has been in operation at approximately 1500 engine rpm for 45 to 60 minutes. Level should be 1/3 to 1/2 way up on sight glass.

If oil is to be added, use special wax-free dehydrated refrigerant type oil having a viscosity equivalent to SAE 10. This oil is readily available through major oil companies. Oil should be obtained in sealed cans. Never use oil which has been exposed to air for any length of time.

ADDING OIL TO A CHARGED SYSTEM

Method Using Portable Hand Pump

NOTE: Compressor oil is added to compressor by means of a pump connected to valve at bottom of compressor as shown in figure 86.

With system leveled out, system operated for 45 to 60 minutes at approximately 1500 engine rpm, add oil as follows:

1. Stop compressor, then remove protector caps from valve stem and line fitting at bottom of compressor.
2. Connect pump supply line loosely to valve fitting. Fill reservoir of pump with recommended oil, then after all air bubbles have vanished, operate pump to purge air from line to compressor valve. Tighten connection at compressor valve.

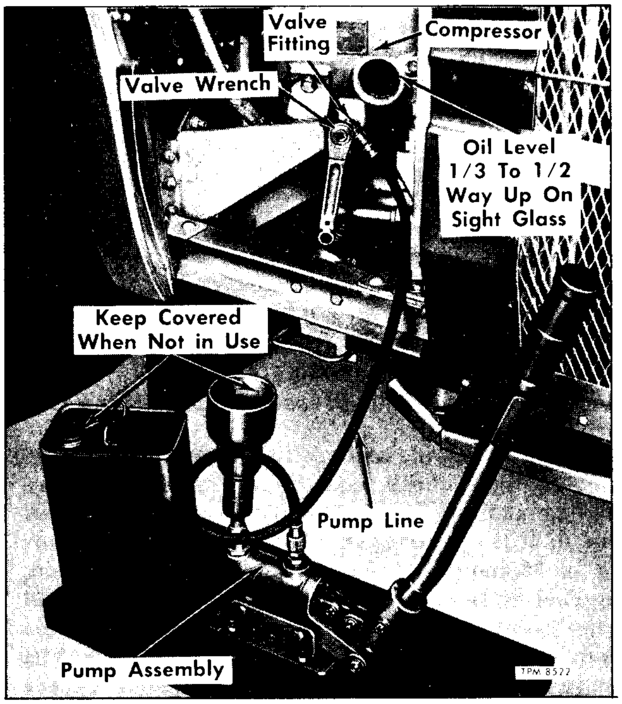


Figure 86—Adding Oil to Compressor Using Hand Pump

3. Open compressor valve by turning stem counterclockwise.

4. Operate pump SLOWLY while checking oil level on compressor sight glass.

IMPORTANT: Keep pump reservoir near full at all times to prevent air from being pumped into system.

Add oil until level is 1/3 to 1/2 way up on sight glass. Close valve at base of compressor, then remove charging equipment.

5. Install protector caps over stem and line fitting of compressor valve.

Method Using Fabricated Oil Pressure Chamber

If a portable hand oil pump is not available, oil can be added with a pressure chamber as described below:

Figure 87 illustrates a chamber which can be fabricated locally using readily available parts. It is easy to visualize many other methods of constructing such a chamber, however, the general principles of the one shown in figure 87 should be followed.

Use chamber as follows:

1. Close both valves ("A" and "B," fig. 87) on oil chamber.

2. Fill the chamber with recommended oil. Hold chamber upright while filling. BE SURE CHAMBER IS COMPLETELY FILLED WITH OIL AND THAT NO AIR IS ENTRAPPED. Install filler plug and tighten firmly.

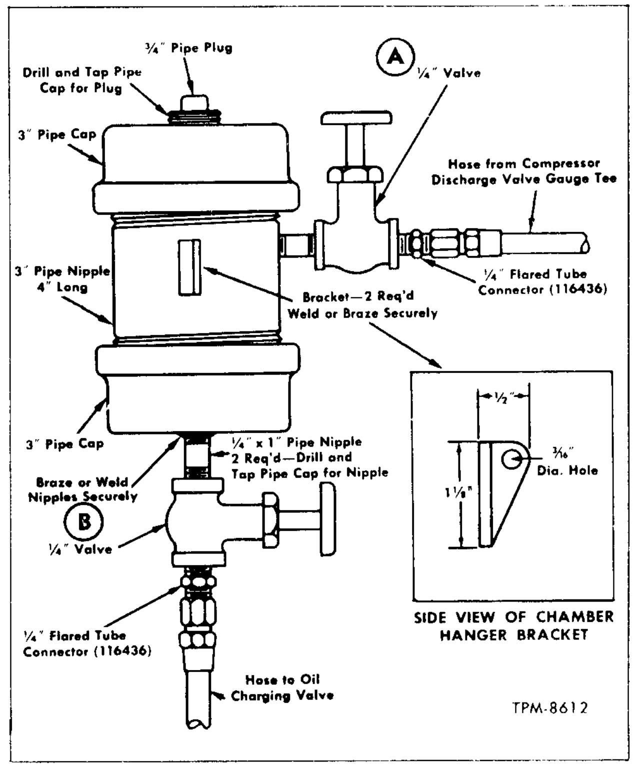


Figure 87—Fabricated Chamber for Adding Oil to Compressor

3. Backseat compressor discharge valve, then connect a hose of sufficient length from upper valve ("A," fig. 87) of oil chamber to test gauge fitting at top of compressor discharge valve. Connect another hose from lower valve ("B," fig. 87) of oil chamber to oil charging valve at top of compressor.

NOTE: Before removing the cap from oil charging valve, make sure the valve is closed. Leave both hose connections loose at the oil chamber valves until air is purged from the hoses.

4. Turn compressor discharge valve stem 1/2 to 1 turn away from the backseated position. Tighten hose connection at side of chamber after a slight amount of gas has escaped. Repeat this operation at the oil charging valve and hose. Leave the discharge valve and the compressor oil charging valve in operating or open position.

5. Start A/C system and operate until system has leveled out.

6. Open both valves on pressure chamber, then watch oil level in compressor sight glass. When oil level is 1/3 to 1/2 way up on compressor sight glass, quickly close chamber valves. Backseat the compressor discharge valve and close the oil charging valve at hose of compressor.

7. Disconnect hoses from compressor. Install caps over compressor fittings.

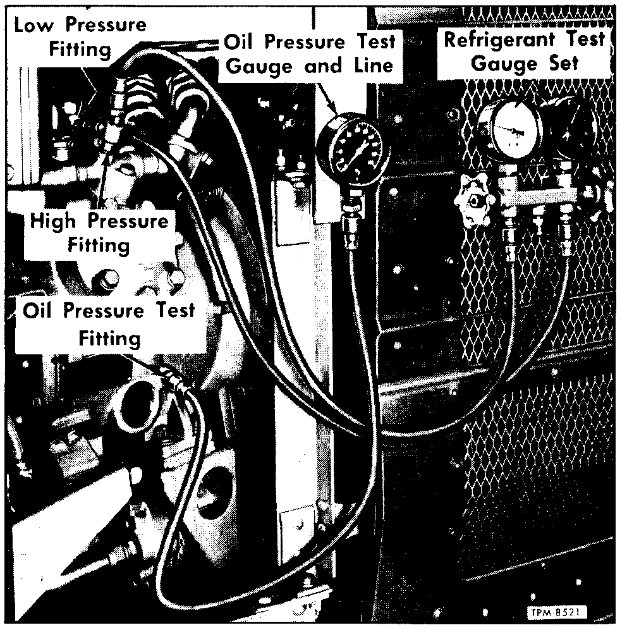


Figure 88—Checking Compressor Pump Pressure

8. Place compressor valves in operating position.

DRAINING EXCESS OIL FROM COMPRESSOR

NOTE: Compressor should be operated for at least 1/2 hour before draining to allow separation of oil and refrigerant.

1. Remove protector caps from stem and line fitting of valve located at bottom of compressor.

2. Connect flexible hose to valve fitting, then open valve slowly by turning stem counterclockwise. Allow oil to flow into suitable container.

NOTE: Special care should be taken when removing oil because of oil foaming. The foaming makes it difficult to determine the amount of oil being removed. Recheck compressor oil level. Close the valve and install protector caps after draining.

CHECKING COMPRESSOR OIL PUMP PRESSURE

To assure proper operation of the compressor, the compressor oil pump must supply the proper oil pressure. The compressor oil pump pressure check is made by subtracting the refrigerant suction pressure reading from the pump pressure reading. The minimum oil pressure reading allowable on pump gauge is 30 psi at 700 rpm engine speed.

Make Check as Follows:

1. Connect refrigerant test gauge to low pressure test gauge fitting (fig. 88). NOTE: For this particular check it is not necessary to connect the gauge set high pressure line to compressor discharge or high pressure fitting as shown.

2. At side of compressor, install oil pressure gauge and hose to compressor oil pressure gauge fitting as shown.

3. Start engine and operate system for 5 to 20 minutes, then check refrigerant suction pressure reading and the pump pressure reading while system is still operating. If refrigerant suction reading is 35 and the oil pump pressure reading is 60, subtract 35 from 60 which leaves 25 psi, the actual pump pressure. If oil pump pressure is below minimum specified, replace compressor pump. The compressor will fail to function properly unless sufficient oil pressure is available.

CONDENSER FAN SPEED CHECK AND ADJUSTMENT

1. Using a tachometer, check speed of fan which should be not less than 1600 rpm when oil in system is hot and engine is operating at 1650 rpm.

2. If speed is less than specified, assuming that sufficient fluid exists in system, it is an indication that the relief valve piston at fan motor is not seating properly, or that either the pump or motor is defective. Piston spring may not have proper tension to allow pressures to level off above 1500 psi. Also small particles of dirt under piston may be obstructing the seating of piston.

3. Small round shims (38, fig. 30) can be added or removed from between relief valve piston spring and the base of valve hex head plug. The adding of shims will increase the setting at which the pressures will level off.

NOTE: Before plug is removed for adding or removing shims it is necessary to drain fluid from this end of system. When reassembled, fluid must be refilled to recommended level.

Trouble Shooting

Most any trouble in the air conditioning system will produce the same symptoms - insufficient cooling.

The following, which is more of a quick reference chart, deals with locating and correcting the common causes of insufficient cooling.

NOTE: Detail trouble shooting information of a specific condition, the possible causes of a condition, its symptoms and the recommended action to be taken is shown later on "Trouble Analysis Chart" page 70.

IMPORTANT

THE MOST COMMON CAUSE OF INSUFFICIENT COOLING IS A DIRTY, CLOGGED CONDENSER COIL. THIS CONDITION SHOULD BE CHECKED FREQUENTLY AND CORRECTED AS EXPLAINED ON PAGE 62.

CONDITION	REMARK
1. Underfloor Blower Not Running	
(a) Loose Electrical Connections	Tighten
(b) Defective Relay	Replace - Page 11
(c) Defective Blower Motor	Repair
2. Dehydrator - Strainer Clogged	Replace - Page 66
3. Underfloor Air Filter Screen Clogged	Page 19
4. Compressor Valves Not in Operating Position	Page 32
5. Improper Engine Idle Speed	Page 77
6. Low Refrigerant	
(a) Leaks in System	Page 65
(b) Recharge System	Page 62
7. Expansion Valve Inoperative	
(a) Capillary Tube Broken	Page 15
(b) Equalizer Tube Restricted	Page 15
(c) Gummed Cage	Page 15
(d) Check for Proper Superheat	Page 15
(e) System Short of Capacity	See "Trouble Analysis Chart"
8. Compressor Clutch Disengages or Fails to Engage	
(a) Dirty Condenser	Page 62
(b) Loose or Broken Condenser Fan Pump Belts	Page 22
(c) Insufficient Fluid in Condenser Fan Drive System	Page 22
(d) Too Much Refrigerant	Page 62
(e) Air in Refrigerant System	Page 65
(f) Insufficient Air Pressure for Clutch Operation	Page 45
(g) Air Leaks in Clutch Operating System	Page 45
(h) Worn Clutch Plates	Replace - Page 47
(j) Refrigerant Valves Not in Operating Position	Page 32
(k) Dehydrator-Strainer Plugged	Replace - Page 66
(l) Defective Clutch Control Air Cylinder	Page 53
(m) Defective Clutch Control Air Solenoid Valve	Page 13
(n) Faulty Clutch Adjustment	Page 45
(o) Small Stones Lodged at Top of Condenser Fan Drive Pump Pulley Grooves	Remove obstruction

9. Compressor Clutch Disengages or Fails to Engage at High Outside Temperatures (Items a, b, c, and e above will cause this condition.)

TROUBLE ANALYSIS CHART

This Trouble Analysis Chart is to supply information for trouble-shooting a specific condition, affected mostly by the operation of the refrigerant compressor. It also contains information on conditions affecting pressures within the refrigerant system.

CONDITIONS OR COMPLAINTS

> NOTE: Reference note numbers listed under each specific condition or complaint refer to information on the possible causes, the symptoms, and also recommendations for making correction. See designated notes below:

Compressor Fails to Start
(See NOTES: 1, 2, 3, 4, 5, 6 and 7)

Compressor "Short Cycles"
(See NOTES: 8, 9, 10, 11, 12, 13, 14 and 15)

Compressor Loses Oil
(See NOTES: 14, 16, 17, 18, 19, 20 and 21)

Compressor is Noisy
(See NOTES: 16, 19, 22, 23, 24, 25 and 26)

Refrigerant Discharge Pressure Too High
(See NOTES: 12, 15, and 30)

Refrigerant Discharge Pressure Too Low
(See NOTES: 13, 31, and 32)

Refrigerant Suction Pressure Too High
(See NOTES: 25, 32, 33, 34, 35 and 36)

Refrigerant Suction Pressure Too Low
(See NOTES: 11, 13, 14, 37, 38, and 39)

System Short of Capacity
(See NOTES: 11, 14, 25, 27, 28, and 29)

NOTES

	Possible Cause	Symptoms	Recommendations	Reference
NOTE 1	Frozen compressor due to locked or damaged mechanism.	Compressor is noisy or will not operate.	Overhaul compressor.	See page 37
NOTE 2	Broken or sheared compressor drive shaft.	Excessive noise at engine or compressor not operating.	Repair or properly connect drive shaft.	See page 46
NOTE 3	Clutch drive plate is worn or saturated with grease.	Slipping action. Odor or smoke in compartment.	Replace clutch plate. Check and adjust clutch control air cylinder push rod travel.	See pages 47 and 45
NOTE 4	Defective clutch control air cylinder or improper linkage adjustment.	Slipping action. Odor or smoke in compartment.	Check and adjust air cylinder push rod travel.	See page 45
NOTE 5	Insufficient air pressure for clutch operation.	Slipping clutch. Odor or smoke in compartment.	Build up at least 65 psi in air system. Check pressure to air cylinder.	See page 45
NOTE 6	Defective clutch control air solenoid valve.	Clutch fails to engage.	Check for open circuit to valve. Loose connections. Defective valve.	See page 13

TROUBLE ANALYSIS CHART (CONT'D)

	Possible Cause	Symptoms	Recommendations	Reference
NOTE 7	Open control circuit. a. Hi-Lo pressure switch. b. Engine oil pressure too high (over 15 psi). c. Engine idling too fast (above 600 rpm).	Open circuit to clutch solenoid valve.	Lower engine idling speed. Engine oil pressure must be below 15 psi. Oil may be cold.	See page 77
NOTE 8	Intermittent contact in electrical control circuit. Compressor valves not in operating position.	Compressor intermittently starts and stops.	Repair or replace faulty electrical control. Check for loose wiring connections. Open compressor valves.	See page 32
NOTE 9	Low pressure switch controller differential set to close.	Frequent starting and stopping.	Check Hi-Lo pressure switch setting.	See page 10
NOTE 10	High pressure switch controls differential too close.	Frequent starting and stopping.	Replace Hi-Lo pressure switch assembly.	See page 10
NOTE 11	Dirty or iced evaporator coil.	Reduced air flow: a. Dirty or clogged air filter screen. b. Underfloor blower inoperative. c. Plugged recirculating air ducts.	Clean air filter screen. Check recirculating ducts for obstructions. Check blower motor.	See page 18
NOTE 12	Overcharge of refrigerant or noncondensible gas.	High discharge pressure	Remove excess refrigerant or purge system.	See page 62 See remark No. 7 later.
NOTE 13	Lack of refrigerant.	Too frequent starting and stopping on low pressure control switch.	Repair refrigerant leak and recharge system.	See remark No. 6 later.
NOTE 14	Clogged refrigerant dehydrator-strainer.	Suction pressure too low and frosting at strainer unit.	Replace dehydrator-strainer.	See page 66
NOTE 15	Faulty operation of refrigerant condensing system.	Compressor cuts off and on from high pressure switch. a. Condenser fan motor inoperative. b. Condenser air inlet or exhaust grille obstructed. c. Condenser coil dirty.	Check and service fan drive system. Remove obstruction. Clean coil.	See page 19 See page 62
NOTE 16	Insufficient oil.	Oil level too low.	Add proper amount of compressor oil.	See page 66

TROUBLE ANALYSIS CHART (CONT'D)

	Possible Cause	Symptoms	Recommendations	Reference
NOTE 17	Traps in hot gas and suction lines.	Oil level gradually drops.	Recheck lines for possible traps. Lines may have been repositioned when body repairs were made.	See remarks Nos. 1 and 5 later.
NOTE 18	Loose expansion valve remote bulb.	Excessive cold suction line.	Provide good contact between remote bulb and suction line.	See remark No. 2.
NOTE 19	Liquid flooding back to compressor.	Excessive cold suction line. Noisy compressor operation.	Readjust superheat setting and check remote bulb contact.	See remarks Nos. 2 and 4 later.
NOTE 20	Short cycling.	Frequent starting and stopping of compressor.	See items previously under "Compressor Short Cycling."	
NOTE 21	Compressor leaking oil.	Oil around base and low oil level on sight glass.	Repair oil leak and add proper refrigerant oil.	See page 37 and 66
NOTE 22	Loose compressor drive shaft.	Coupling flange bolts and nuts loose.	Tighten flange coupling nuts.	See page 46
NOTE 23	Dry or scored compressor crankshaft seal.	Squeak or squeal when compressor is running.	Check oil level. Replace compressor seal.	See page 37
NOTE 24	Internal parts of compressor broken.	Noisy compressor.	Overhaul compressor.	See page 37
NOTE 25	Expansion valve stuck in open position.	Abnormal cold suction line. Compressor knocks.	Repair or replace expansion valve.	See remark No. 2 later. See page 15
NOTE 26	Compressor hold-down mountings loose.	Compressor vibrates excessively.	Tighten or replace mountings.	See page 34
NOTE 27	Flash gas in liquid line.	Expansion valve hisses.	Add refrigerant.	See remark No. 6 later.
NOTE 28	Excessive pressure drop in evaporation.	Superheat too high.	Check superheat and reset expansion valve.	See remark No. 4 later.
NOTE 29	Improper superheat adjustment.	Short cycling.	Adjust expansion valve.	See remark No. 4 later.
NOTE 30	Air or non-condensible gas in system.	Exceptionally hot condenser and excessive discharge pressure.	Purge system.	See remark No. 8 later.
NOTE 31	Broken or leaky discharge valves within compressor.	Suction pressure rises faster than 5 lbs. per minute after pressure shut-down.	Remove compressor head, examine valves and if necessary, replace.	See remark No. 9 later.

TROUBLE ANALYSIS CHART (CONT'D)

	Possible Cause	Symptoms	Recommendations	Reference
NOTE 32	Leaky relief valve in compressor.	Insufficient cooling.	Replace relief valve.	See page 37
NOTE 33	Excessive load on evaporator.	Insufficient cooling.	Check for leaks in evaporator compartment. Check air filter screen and blower motor.	
NOTE 34	Overfeeding of expansion valve.	Abnormally cold suction line. Liquid flooding back to compressor.	Check contact of expansion valve remote bulb in suction line well.	See remarks Nos. 4 and 5 later.
NOTE 35	Broken suction valves within compressor.	Noisy compressor.	Remove compressor head, examine valves and if necessary, replace.	See remark No. 9 later.
NOTE 36	Compressor worn.	Insufficient cooling.	Overhaul compressor.	See page 37
NOTE 37	Expansion valve power unit has lost charge.	No flow of refrigerant through valve.	Replace expansion valve assembly.	See remark No. 3 later.
NOTE 38	Obstructed expansion valve.	Loss of capacity.	Clean or replace expansion valve.	See page 15
NOTE 39	Too much pressure drop through evaporator coil.	Superheat too high.	Check for plugged external equalizer line at expansion valve.	See page 15

TROUBLE ANALYSIS CHART REMARKS

REMARK
NO. 1 - CLOGGED REFRIGERANT DEHYDRATOR-STRAINER (Refer to Fig. 11)

Occasionally the dehydrator-strainer in the liquid line may become clogged with foreign material in the system. When this happens, the liquid line leaving the strainer will feel cooler than the liquid entering. If it is badly clogged, some sweat or frost may appear at strainer outlet.

REMARK
NO. 2 - REFRIGERANT EXPANSION VALVE STUCK IN OPEN POSITION (Refer to Figs. 12, 14, and 15)

If the expansion valve is stuck in an open position, there will be an excessive amount of sweating on the suction line and compressor crankcase due to the large amount of liquid being passed into the suction line.

REMARK
NO. 3 - REFRIGERANT EXPANSION VALVE HAS LOST CHARGE (Refer to Figs. 12, 14, and 15)

The power element of expansion valve consists of the remote bulb, capillary tube and the diaphragm, which actuates the valve cage. If this power element is inoperative or has lost its charge, the valve will either maintain an almost closed position or may close completely. Test for an inoperative power element as follows:

a. Stop compressor.
b. Remove remote bulb from well in suction line at end of evaporator coil.
c. Carefully place remote bulb in container filled with ice water.
d. Start compressor.
e. Remove remote bulb from ice water and warm in hand. At the same time check suction line for rapid temperature change which indicates flood-through of liquid refrigerant. If refrigerant floods through valve, power unit is operating properly.

WARNING: Do not flood-back through suction line for too long a period as excessive liquid flood back could cause severe damage to compressor.

TROUBLE ANALYSIS CHART REMARKS (CONT'D)

REMARK
NO. 4 - REFRIGERANT EXPANSION VALVE IMPROPERLY ADJUSTED (Figs. 12, 14, and 15)

If the expansion valve is adjusted for too low a superheat, too much liquid will be passed into evaporator. The suction line will be normally cold and liquid may slug back to the compressor. If expansion valve is adjusted for too high a superheat, too little liquid will be passed to the evaporator and the suction line will be abnormally warm. Superheat must always be adjusted carefully using thermometer (fig. 15) and suction gauge.

REMARK
NO. 5 - REFRIGERANT EXPANSION VALVE IS OBSTRUCTED (Refer to Figs. 12 and 14)

Foreign material may obstruct the valve port. If the obstruction is small, the resulting operation will be a "hunting" condition which will cause a suction pressure variation of possibly 10 to 15 psi on suction pressure test gauge. If the obstruction is large and only a small trickle of liquid can pass, the compressor will short cycle. If the obstruction holds the valve open during shutdown, liquid will flood back to compressor. This causes liquid slugging to compressor at start-up, which is definitely harmful. Compressor will knock when this occurs. An obstructed expansion valve is usually indicated by a partly warm evaporator and frosting at the evaporator inlet.

REMARK
NO. 6 - SHORTAGE OF REFRIGERANT

There should always be sufficient liquid in the receiver tank (1/2 way up on sight glass) to completely submerge the inlet to the liquid line pipe. If there is a shortage of refrigerant, the liquid level will fall below the inlet to the liquid line and a mixture of gas and liquid will pass into the liquid line. Bubbles will appear in the sight glass, the larger the bubbles the more severe the refrigerant shortage. Frequently there will be a hissing or whistle at the expansion valve. The coil and suction line will be relatively warm while the suction pressure will be low due to little or no liquid being supplied to the evaporator if the shortage is severe.

REMARK
NO. 7 - OVERCHARGE OF REFRIGERANT

An overcharge of refrigerant will cause high head pressure. Liquid will back up in the condenser and decrease the amount of surface available for condensing and as a result the head pressure will rise. In extreme cases, it may rise to a point where the high pressure cut-out switch will stop the compressor. This may result in compressor short cycling.

REMARK
NO. 8 - AIR IN SYSTEM, PURGING

If air or non-condensible gases are present in the system, they will usually tend to move toward and collect at the condenser. The head pressure will rise to a point above the pressure corresponding to the temperature at which the vapor is condensing. In extreme cases, the pressure may rise to a point where high pressure cut-out switch will stop the compressor.

To determine whether or not there is air in the system, the compressor must be allowed to stand idle long enough for the entire system to cool down to the temperature of the surrounding air. After the system has attained the same temperature as the surrounding air, the reading of the head pressure test gauge should not be more than 12 lbs. above the saturation pressure corresponding to the surrounding air temperature. See "Refrigerant, Pressure-Temperature Relationship" chart, page 18.

REMARK
NO. 9 - BROKEN VALVES IN COMPRESSOR

Broken suction valves or broken or leaky discharge valves within the compressor are generally indicated by the suction pressure rising rapidly as soon as the compressor is stopped. If the suction pressure rises faster than 5 lbs. per minute, it is an indication that the compressor discharge valves are not holding. Before the compressor is torn down, however, it should be determined that the pressure rise is not due to a leaky expansion valve.

Air Cond. Lubrication and Inspection

The following tabulation lists lubrication and service points, service required, and the recommended intervals at which these services should be accomplished. These services should be accomplished at more frequent intervals when system is operated under severe conditions such as extremely high temperatures. References in right-hand column refer to page numbers where service procedures are covered, or to Lubrication Notes below for recommended lubricant and proper application.

Item	Service Required	Daily	At Inspection	See Footnote	Refer to
Compressor	Check Oil Level - Add if Required	X			Page 66 (Note 1 below)
	Drain and Refill			(A)	--
	Check Tightness of Mounting Bolts		X		--
Compressor Suction and Discharge Valves	Check Tightness of Mounting Bolts and Valve Caps		X		--
Liquid Receiver Tank	Check Refrigerant Level	X			Page 62
	Check Tightness of Mounting Bolts		X		--
Condenser	Clean Coils as Necessary	X			Page 62
Condenser Fan Drive Pump Belts	Check Belt Tension		X		Page 22
Dehydrator Strainer	Replace Cartridge			(B)	Page 66
Underfloor Air Filter Screen	Clean and Re-oil		X		(Note 2 below)
Evaporator Coil	Clean		X		Page 18
Hi-Lo Pressure Switch	Check Adjustment		X		Page 10
Driver's Control Panel	Tighten Connections		X		--
Condenser Fan Fluid Drive	Check Oil Level - Add if Required		X		Page 61 (Note 3 below)
Compressor Drive Propeller Shaft	Lubricate with Hand Gun		X		(Note 4 below)

(A) After initial 200 hours of operation.

(B) Whenever system has been opened.

NOTE 1—COMPRESSOR OIL

A special wax-free dehydrated refrigerant type oil having a viscosity about the equivalent of S.A.E. 10 must be used. This oil is readily available through major oil companies. Approved oils are: Texaco Capella D; Ansul 300 non-foaming; Std. Oil of Calif., Caloil 13W. Oil should be obtained in sealed cans. Never use bulk oil or oil which has been exposed to air for any length of time. Drain and refill after first 200 hours of operation. After this change only at overhauls. The compressor capacity is 4 pints.

NOTE 2—ODORLESS OIL

Air Filter Screen. Thoroughly clean filter screen, then spray, or dip and let drain, with light odorless oil, such as medicinal white oil.

NOTE 3—HYDRAULIC FLUID

Condenser Fan Drive System. Use Type "A" Automatic Transmission Fluid. System capacity is 6 quarts. IMPORTANT: Keep fluid container covered while not in use.

NOTE 4—GEAR OIL

Compressor Drive Shaft Universal Joints. Apply small quantity of gear oil to two fittings (fig. 57) at coach regular lubrication intervals.

Equipment and Materials

The following equipment and materials are required for servicing the Air Conditioning System. This equipment and material can be procured locally or from any reliable air conditioning or refrigeration supply house.

EQUIPMENT

Thermometer with Remote Reading Dial - For use in conjunction with expansion valve adjustment.

Soldering Torch and Cylinder of Gas - For soldering refrigerant line fittings.

Oil Pressure Gauge - For checking compressor oil pump pressure.

Leak Detector - For detecting refrigerant leaks.

Vacuum Pump and Gauge - For evacuating the system. Should be capable of pulling 28 to 29 inches of mercury vacuum.

Test Gauge Fitting Hose Connectors - For adapting service refrigerant hoses to gauge fittings (KM Tool No. 12-081).

Wet Bulb Indicator - For checking amount of air and moisture in system while evacuating system.

Hand Oil Pump - For adding oil to a charged system.

Pressure and Vacuum Gauge Set - For checking Refrigerant-12 system operation.

- With combination vacuum air pressure gauge
  - 0 to 30" vacuum scale.
  - 0 to 150 lbs. pressure scale.
- With high pressure gauge - 0 to 400 lbs. scale.

MATERIALS

Anhydrous Methyl Alcohol - For use in leak detector.

Refrigerant 12 - Dichlorodifluoromethane. Do not use any other type of refrigerant in this system. (Approximately 35 lbs. required in system, available in 25 lb. cans.)

Solder - 95% tin and 5% antimony - For soldering refrigerant line fittings.

Nokorode Soldering Paste - For use on soldered fittings.

Specifications

AIR CONDITIONING REFRIGERANT CONTROL SPECIFICATIONS

COMPRESSOR

Make	Trane
Model	C5H30
Trane Part No.	Com-338
GM Part No.	2412833
Rated Capacity at 2000 RPM	
Maximum Head Pressure	250 psi (gauge)
Suction Pressure	10-45 psi (gauge)
Initial Oil Charge	4 pts.

DEHYDRATOR - STRAINER

Make	Tube Manifold Corp.
Type	Disposal

EXPANSION VALVE

Make	Alco Valve Co.
Adjustment	External
Setting	8° - 12° Superheat

HI-LO PRESSURE CUT-OUT SWITCH

Make	Penn. Electric Switch Co.
Type	1277MP12
Model	1502
High Pressure Switch	
Opens at	250 psi (gauge)
Closes at	185 psi (gauge)
Low Pressure Switch	
Opens at	7 psi (gauge)
Closes at	22 psi (gauge)

AIR CONDITIONING MISCELLANEOUS SPECIFICATIONS

CONDENSER FAN DRIVE
System Hydraulic Fluid Capacity
(Approx.) . . . . 6 qts.
Fan Motor Speed (At 1650 Engine RPM
- With Hot Oil) . . . . 1600 to 1700 rpm

Fluid Pump Assembly
GM Part No. 2412832
Make . . . . Sundstrand Machine Tool Co.
Model No. GP-B05L-2000-1

Fan Motor Assembly
GM Part No. 2412875
Make . . . . Sundstrand Machine Tool Co.
Model No. GM-B05L-2001-1
H.P. Rating . . . . Approx. 3

Fluid Reservoir Assembly
GM Part No. 2423739
Make . . . . Sundstrand Machine Tool Co.
Model No. 30RFS-100-1

AIR CONDITIONING CONTROL RELAY
Make . . . . Delco-Remy
Stamped 1116899
Air Gap (With points closed) . . . . 0.014"
Point Opening . . . . 0.028"
Closing Voltage Range 8.5-10.5
Opening Voltage . . . . 4.3 min.

CLUTCH CONTROL AIR CYLINDER
GM Part No. 2415905
Make . . . . Midland-Ross
Stamped N-3869
Stroke . . . . 1.120"

COMPRESSOR DRIVE CLUTCH
Clutch Size . . . . 9-1/8"
Type . . . . Single Plate, Dry Disc
Release Bearing Type . . . . Sealed-Ball

CLUTCH CONTROL MAGNET VALVE
Make . . . . Skinner Chuck Co.
Stamped 2419272
Model No. V5-22355

AIR CONDITIONING ENGINE
OIL PRESSURE SWITCH
Make . . . . AC
Stamped 1509175
Contact Break Pressure . . . . 15 ± 2 psi

AIR CONDITIONING CLUTCH
CONTROL AIR PRESSURE SWITCH
Make . . . . AC
Stamped 1508844
Contact Closing Pressure . . . . 65 psi

ENGINE IDLE SPEED

NORMAL . . . . 465 rpm
FAST IDLE (Switch Controlled) . . . Approx. 950 rpm

Special Tools

References are made to special tools in some sections of this manual. These tools, or their equivalent, are necessary and are recommended to readily and efficiently accomplish certain service operations. These tools, however, are not supplied by GMC Truck & Coach Division. Information regarding availability of these tools can be obtained from your GM Coach Service Representative or from the Factory. Following is a list of all special tools referred to throughout the manual.

SECTION 2 - REAR AXLE

J-4856	Differential Bearing Remover Plug
J-8176	Bearing Puller
J-3940	Pinion Bearing Cup Remover

SECTION 3 - BODY

GENERAL BODY MAINTENANCE

J-2189	Seal and Insert Installer

HEATING SYSTEM

80-0202	Puller Tool (Booster Water Pump)

SECTION 7 - ELECTRICAL

1568147	Electric Speedometer Test Light
J-6663	T-3 Headlight Aimer

SECTION 8 - ENGINE

VO-233	Spanner Wrench

SECTION 14 - AIR SUSPENSION

J-6888	Valve Core Replacer
J-8424	Overtravel Lever Piston Compressor
115-3	Vacuum Line Fitting

SECTION 16 - STEERING

MECHANICAL STEERING

J-544-01	Spring Scale
J-2927-01	Steering Wheel Puller
J-489	Bearing Puller
J-3186	Pitman Arm Puller
J-8176	Bearing Puller
J-3187-A	Side Cover Bearing Puller
J-2619	Slide Hammer (use w/J-3187-A)
J-5529	Needle Bearing Remover and Replacer

POWER STEERING

J-5631-1	Pressure Checking Gauge

SECTION 19 - WHEELS AND TIRES

TA-602A	Torque Wrench
TQ-602AL	Torque Wrench with Indicator Light

SECTION 26 - AIR CONDITIONING

12-081	Test Gauge Hose Connectors

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